ENGINEERING NEWS
AND
AMERICAN RAILWAY JOURNAL.

Vol. XXXII, No. 22.

TABLE OF CONTENTS.

ENGINEERING NEWS OF THE WEEK 439
The Drainage Works of the Ontario Silver Mine, Utah (illustrated) 440
Sewage Purification at the Lawrence, Mass., Experiment Station in 1893 443
The Maximum Practicable Length of Suspension Bridges 444
Weather Report for October 446
Power House and Electric Locomotives for the Baltimore Belt Railway Tunnel (illustrated) .. 450
The Thackeray Garbage Incinerator at Montreal (with inset) 451
The Report of the New York Garbage Commission 452
The Webber Combined Brake and Fender for Street Cars (illustrated) 452
Water Purification at Lawrence Experiment Station 453
PERSONALS, NEW PUBLICATIONS, SOCIETY PROCEEDINGS 446, 447
EDITORIAL NOTES 448
The Blackwell's Island Bridge—A Warning to those Seeking Employment on the Panama Canal—The Validity of the Hall Patent for Producing Aluminum—Protection to "Pioneer" Inventors—Sewage Filtration at the Rate of One-Third Million Gallons a Day.
EDITORIAL:
Shall Freight be Handled on the New York Rapid Transit Railway? 448
LETTERS TO THE EDITOR 448
A Long Multiplication Table—Diagram for the Discharge of Sewers (illustrated)—Natural Cement as Material for Concrete.
CONSTRUCTION NEWS 453
Railways, Street and Electric Railways, Elevated Railways, Highways, Bridges, Water-Works, Artesian Wells, Irrigation, Sewers, Streets, Electric Light and Power, Garbage Disposal, Miscellaneous Contracts and Supplies, Condensed List of Contracts Pending with Date of Opening Bids, Contract Prices, Metal Market Prices.
INDUSTRIAL NOTES 458
STOCK AND BOND MARKET 458

The Long Island R. R. bridge over the East River at Blackwell's Island is now a certainty, according to a statement publicly made by Mr. Austin Corbin, President of the Long Island R. R., on Nov. 24. Work on the foundations is now in active progress, and bids for the superstructure from the various bridge building companies are now being considered. The bridge is to be a cantilever structure with three spans, two of 846 ft. each, over the east and west channels, respectively, and one over Blackwell's Island, 613 ft. long. The bridge will carry four railway tracks and there will be a carriageway and sidewalks on each side. The clear headway between the channel spans and high-water mark will be 135 ft., the same as that of the Brooklyn Bridge. The total height from the top of the cantilever to high-water will be 255 ft. The estimated quantities are as follows:

Masonry in four cantilever piers, cu. ft.	810,000
Masonry in two anchor piers, cu. ft.	216,000
Total weight of steel in superstructure, lbs.	53,000,000
Total weight steel in viaduct approaches, lbs.	25,000,000
Weight of superstructure per lin. ft. (about)	11 tons.

The New York terminal station of the bridge will cover the entire block between Second and Third Aves., and 62d and 63d Sts., and will contain 12 tracks, at an elevation of about 60 ft. above the ground. It is expected that the entire structure will be completed and ready for traffic in 1897. Mr. Charles M. Jacobs, C.E., 192 Broadway, New York, is the Chief Engineer of the work.

Smoke prevention on locomotives was considered at a recent conference at St. Louis between the Master Mechanics and Superintendents of Motive Power of all the railways entering the city and the City Smoke Abatement Commission. The following resolutions, drawn up by a committee consisting of Messrs. Bartlett, of the Missouri Pacific; Johnson, of the East St. Louis Connecting Ry., and Groves, of the St. Louis & San Francisco, were unanimously approved by the railway officers present:

Whereas, It come to our knowledge by the past experience of all the members of the mechanical departments, who have made the matter of smoke abatement years of study, that up to the present day there has not been any device that will insure with the use of bituminous coal the abatement of smoke; therefore, be it

Resolved, that we fear that the constant demands of the Smoke Abatement Commission to devise some means for the prevention of smoke in the cities is a demand which cannot be satisfactorily complied with to entirely abate the smoke on locomotives.

Resolved, that the members of the Mechanical Association will use their best endeavors with the firemen in charge of the engines to do their utmost by proper firing and attention to abate the evil, and that they will do all possible to comply with the ordinance, believing this to be the only solution of the smoke problem as far as locomotives are concerned; that they will also hail with pleasure the discovery of any device by the Smoke Abatement Association which can reasonably be applied to a locomotive for the prevention of the nuisance.

The torpedo-boat "Ericsson" had her fourth breakdown in the official trials at New London, Conn., on Nov. 22, and the trial had to be again abandoned. Naval officers seem to think the boat is badly handled, and suggest that a regular naval crew be substituted for the Mississippi River men now in charge. The contract speed is 24 knots, and the vessel was making 23 knots when the last accident occurred, the breaking down of the starboard air-pump.

The most serious railway accident of the week was a head collision of passenger trains Nov. 21 at Oxford, Mass., on the New York & New England R. R. The southbound train had orders to pass the northbound train at this point, but through some misunderstanding it occupied the main track. An attempt was made to switch the northbound train onto the side track, but it was too late. Four persons pere injured.

Thawing frozen dynamite cartridges caused an explosion at the new water-works reservoir at Charleston, W. Va., Nov. 23, by which two men were killed and a third injured.

A cave-in occurred in a sewer trench at Plainfield, N. J., Nov. 22. The Second Ave. sewer trench is partly in quicksand, and a heavy stone for a manhole foundation fell into the excavation, knocking out a number of the cross timbers so that the pressure of the quicksand burst in the sheathing. One man was killed by the stone falling upon him, and another was injured by being crushed in the slide.

A trestle near Blum, Tex., on the Atchison, Topeka & Santa Fe Ry., gave way Nov. 22, and several cars were wrecked.

A safety plug in the firebox of an engine on the Chicago & South Side Elevated Ry. blew out Nov. 20, while the engine was hauling a train near 24th St. The rush of steam and water blew the fire onto the track and started several small fires in the backyards of the houses. The fireman was injured by jumping from the cab.

A lock with a total lift of 140 ft. is proposed as a substitute for the flight of 16 locks on the Erie Canal between West Troy and Cohoes. At present two to three hours are required for the passage of these locks, the delay being especially great because the locks are all single length. Thus far, 40 out of the remaining 72 locks on the Erie Canal have been enlarged to double length; but to carry out this improvement on the flight of 16 would be very difficult on account of lack of space, increased demand for water and the great expense involved. The proposed high-lift lock would consist of two steel tanks, each large enough to contain a boat and its consort, or equal in capacity to the largest locks now in use on the canal. The two would balance each other, one ascending as the other descends, so that the only power required would be that necessary to overcome the friction of the machinery. The scheme is being investigated by the State Engineer, Mr. Campbell W. Adams.

The new Krag-Jorgensen .30-in. caliber rifle is being issued to the U. S. Army, the first 2,000 being now completed at the Springfield Armory. With it goes the new knife-bayonet, 12 ins. long, 1 in. wide and double-edged, with a handle of wood and steel. Before the end of next year the entire army will be equipped with the new weapon.

The Cunard Steamship Company is considering the advisability of sending its steamers from Southampton instead of Liverpool. Delays at Queenstown, the lack of direct railway connection with the docks at Liverpool and the want of a deep-water landing pier at the same port are the causes stated for the proposed change of terminus.

According to press despatches, the preliminary surveys of the proposed ship canal from St. Paul and Minneapolis to Lake Superior (Eng. News, Nov. 1) have been completed. The total amount appropriated for making the surveys was only $10,000. The route favored is that via the St. Croix and Brule rivers. Its total length is about 162 miles. In the first 18 miles from Lake Superior 409 ft. of elevation would have to be overcome. The summit level would be 24 miles long, and there would then be a descent of 408 ft. to the Mississippi River at Prescott. If the locks have a lift of 30 ft. each, the total number required would be 30, and it is thought that they could be built for $2,000,000 each. Allowing $30,000,000 for the remaining cost of the canal, this would make the total cost $90,000,000.

One day's business of the U. S. Post Office Department, says Postmaster-General Bissell in his last report, is represented by the following items:

Miles of post route run	1,100,000
Stamps manufactured	8,300,000
Envelopes manufactured	1,800,000
Postal cards manufactured	1,500,000
Total pieces mailed	15,700,000
Letters mailed	7,400,000
Pieces mail matter distributed and redistributed	27,500,000
Pieces handled in Dead Letter Office	24,000
Transactions in money order business	$1,100,000
Daily expenses	$231,100

The total revenue of the Department for the last fiscal year was $75,080,479, and the total expenditures were $84,324,214, leaving a deficiency of $9,243,935. The later is partially accounted for by financial depression throughout the country.

The reduction of the speed of trolley cars to six miles per hour on the streets of Brooklyn is the substance of a resolution now before the Common Council of that city, and is a direct outcome of late frequent fatal accidents. Mr. Daniel F. Lewis, President of the Brooklyn Heights Ry., spoke against the resolution and said that the law, if enforced, would reduce the actual speed to 4½ miles per hour, if ordinary obstructions to traffic were considered. He said that horse-cars were run at as much as 7½ miles per hour with no complaint, and he wants the electric cars to average 10 miles per hour, and contends that this is a perfectly safe speed, and is the limit provided for in the company's charter. The cable cars in New York are operated safely at 9 miles per hour. He practically charges that the present effort to reduce the speed to much less than that of the old horse-car system is mainly instigated by the opposition of the elevated railways, which feel the competition of the fast surface lines. Action upon the proposed resolution was referred to a committee.

The construction of the proposed Jungfrau railway has been sanctioned by the Swiss authorities. As planned, the railway will ascend the upper part of the mountain by a series of spiral tunnels. The railway will end on a little rocky plateau on the western slope, and a vertical elevator will carry passengers up the final ascent. A look-out will be made on the narrow summit ridge by blasting.

One of the Melan concrete arches built Oct. 19 and described in our issue of Oct. 25, was tested Oct. 27 by a load of paving stones estimated to weigh 5,000 lbs., the bottom stone being 18 × 24 ins., resting on planks laid upon the arch. On Nov. 1 it was again tested in a similar way, the load being estimated at 16,000 lbs., and with a base of 6 × 2 ft. No distortion or fracture occurred. These tests were only intended to be approximate, as the tests to destruction will not be made until the arches are three weeks old.

A conference of manufactures has been called by the Manufacturers' Association of Cincinnati and Hamilton County, O., to meet at Cincinnati, Jan. 22, 1895, for the formation of a National Manufacturers' Association, the purposes of which shall be the advocacy of legislation for the encouragement of manufacturing industries, the improvement of trade relations between the United States and foreign countries, and the establishment in South American capitals and other desirable points of permanent expositions of American products. Mr. E. P. Wilson, Chamber of Commerce Building, Cincinnati, is the Secretary of the Association.

Constitution changing seems to be the order of the day in the engineering societies. The Civil Engineers recently made some important and much-needed changes in their constitution, as was fully recorded in these columns, and the Mechanical Engineers, at their meeting next week, are to vote on a considerable number of changes to their "Rules." The change of most interest is that which places an age limit on members, requiring an Associate to be at least 26 years of age and a Member at least 30 years. It is also provided that an applicant for membership who fails of election (seven votes are sufficient to defeat) may have his name again presented for letter ballot by a three-fourths vote of the Council, and in this election 13 negative votes shall be required to defeat. Honorary Members are to be chosen by a unanimous vote of the Council by letter ballot, and their names are not submitted to a letter ballot by the members, as heretofore. The other changes proposed are of minor importance.

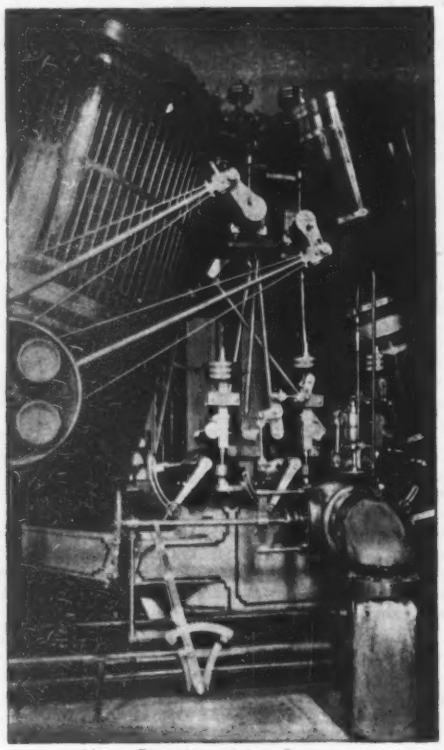
A high wheel similar to the Ferris Wheel is to be erected in London; it is composed of 39 segments. In placing the first 20 segments each segment will be put on in a vertical position and the completed portion of the wheel will be revolved 9° after the segment is in place. The remaining 19 sections will be added in a horizontal position from timber towers.

THE DRAINAGE WORKS OF THE ONTARIO SILVER MINE, UTAH.

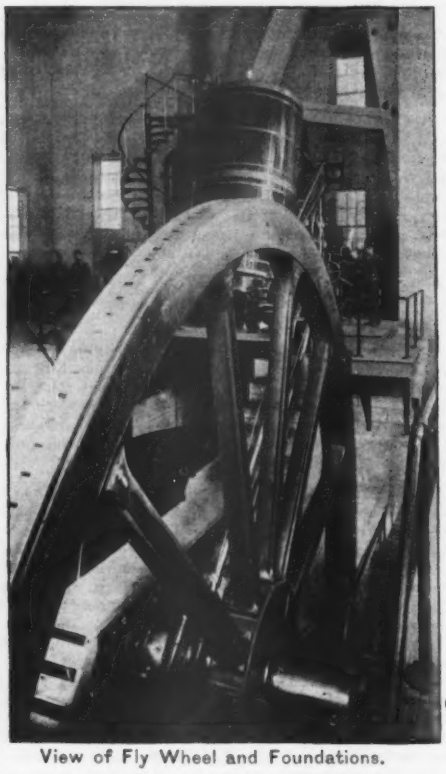
By W. P. Hardesty, C. E.

The Ontario Mine is in the Utah mining district of Utah, in the Wahsatch mountains, and is about 1½ miles south of the center of Park City, which is reached by the Utah Central Ry. from Salt Lake City (35 miles), and by the Union Pacific Ry. from Salt Lake and Ogden. Here, within a small area, is a group of some of the best silver properties in the West. The Ontario Mine, lying on the famed Ontario lode and owned by the Ontario Silver Mining Co., was opened in 1872, and has been steadily worked and constantly extended since then. Since 1876, 446,825 net tons of ore have been extracted from it, yielding 29,208,508 oz. of silver, which sold for $28,457,495, of which the stockholders received in dividends $13,175,000.

It is what is known as a "wet" mine and the draining of the water has been one of the largest items of expense in operation. As the shafts have been deepened and new levels have been run, the quantity of water to be disposed of has steadily increased. In July, 1883, the first drain tunnel of any length was



View Showing Valve Gear.



View of Fly Wheel and Foundations.

PERSPECTIVE VIEWS OF CORNISH PUMPING ENGINE, ONTARIO MINE.

finished. This led from shaft No. 3, at the 600-ft. level, north for about 1¼ miles, discharging below the Ontario Mill in Park City. This tunnel required 25 months for its construction, and cost $22 per lin. ft. Up to this time the water had been pumped up this shaft by several sets of steam pumps placed on the different levels, and discharged through a short tunnel 145 ft. below the top. The quantity pumped then averaged about 4,500 gallons per minute. As soon as the tunnel was completed, it drained nearly all the ground down to the 600 ft. level, leaving only the water below this level to be pumped.

The operation of steam pumps so far underground, however, was found very expensive, and in 1882 work was begun installing a large Cornish pumping engine, and it was put in operation in 1883, being located at the mouth of shaft No. 3. This is one of the largest and most powerful pumping engines ever built. The general design of the engine was by W. R. Eckart, mining engineer, of San Francisco, and it was built by I. P. Morris & Co., of the Port Richmond Iron Works, Philadelphia. The two cylinders are nearly vertical, being at the same height, and inclined toward each other at the top. The high pressure is 38½ ins. in diameter, and the low pressure 70 ins., and the stroke of each is 10 ft. The cylinders are both steam-jacketed, and have cut-off valves, though the steam is usually controlled by the throttle valve. The piston rods are connected to the opposite ends of a walking beam or "bob," while the connecting rod to the crank which turns the flywheel shaft is attached to a pin at the top of the bob. This connecting rod is 28 ft. long, while the arms are 14 ft. 6 ins. The flywheel is 30 ft. in diameter and weighs 56 tons, its shaft being 22 ins. at the flywheel, 16 ins. at outboard journal, and 20 ins. at crank-end journal. The engine's speed is five to seven revolutions per minute, and it works with a steam pressure of 100 lbs.

The engine uses a jet condenser. The connecting rod to the pump-rod is attached to the bob at the same end as the connecting rod of high-pressure cylinder, but lower down, the distance c. to c. of pins being 4 ft. 2 ins., with 14-in. diameter journals, the journals for pins for engine connections being 10½ ins. diameter.

The total weight of the bob is 75 tons. The foundations of the engine are 54 ft. below the surface, the cut-stone masonry being carried up. Over 7,000 tons of quarried work were required in the foundations. The pump shaft is 7×9 ft., with enlargement at pump and bob stations, and is heavily timbered.

The pumps are located at the 1,000-ft. and 800-ft. levels, water being pumped up to the 600-ft. level. The pump-rod is made of 16-in. square Oregon pine, in 60 to 80-ft. lengths, the joints being made by four straps of iron, 1 × 12 ins. × 30 ft., thus giving a lap of 15 ft.; suitable guides are placed at intervals of 25 ft. The two pump columns are 18 ins. in diameter, and are of riveted wrought iron.

At the 300-ft., 500-ft. and 700-ft. levels are placed balance bobs connected with the pump-rod, the design being to give the engine the same amount of work on the up and down strokes. These balance bobs each have counter-weights of 29 tons. The two pumps at the 1,000-ft. level have 20-in. plungers, with 10 ft. stroke. The sump is 45 ft. deep, but is nearly always full, the suction never exceeding 10 ft. Between 300 and 350 gallons are pumped at each stroke, the water discharging from the lower pumps into tanks located upon the 800-ft. level, where two pumps similar to those at the bottom are put in. In September of the present year the engine was handling about 1,500 gallons per minute. Its capacity is about 2,500 gallons. The engine and pumps cost at the factory $110,000, while the total cost, including foundations, the erection, buildings, pump-shaft equipment, etc., was about $250,000.

Besides the Cornish pump there are four steam pumps under ground to relieve it in emergencies, and to act as auxiliaries during largest flows of water. There is one each at the 1,000 and 800-ft. levels of shaft No. 3 and of shaft No. 2 (but a few hundred feet away, and well connected with No. 3). These are 23-in. and 42-in. Knowles compound pumping engines, and have each a capacity for 1,600 gallons per minute raised 200 ft., the raise being divided into 200-ft. lifts by the 800-ft. level.

There are two additional columns of 15 ins. diameter each in the pump shaft for these pumps. Steam is supplied to pumps in No. 3 shaft by a 6-in. pipe, jacketed with 1½ ins. of asbestos, and about 1,100 ft. long in all.

The work done by the Cornish engine has been at a great saving over that of the direct-acting pumps under ground. Coal is hauled from the mines at Coalville, 22 miles distant, on the U. P. Ry., and costs $4 to $4.50 delivered at the mine. As the battery of boilers at shaft No. 3 supplies all the other engines there, however, the outlay for coal for pumping alone cannot be accurately stated. In general, however, the expense for pumping has always been heavy, and there are large bodies of ore below the 1,000-ft. level which must be worked. Hence it was early foreseen that with the opening of all this new ground and tapping new supplies of water the pumps would be totally inadequate to handle it. In 1888 surveys were begun to locate a drainage tunnel that would drain all the ground down to the 1,500-ft. level, the lowest level that has been reached, and that only by shaft No. 2. Very thorough surveys were made by Mr. O. A. Palmer, of Salt Lake City, the company's mining engineer, by whom the new tunnel was located, and under whose surveys the work has been continued. This tunnel runs from the foot of No. 2 shaft, at the 1,500-ft. level, in an easterly direction, and discharges into a gulch on east side of the range, leading into the valley of the Provo River near its head. The length is 15,490 ft., the grade ½ in. to the rod, or 3 ins. per 100 ft. It will ultimately be extended from shaft No. 2 along the foot-wall of the vein and parallel to it (so as to draw off the water more effectually) and on through the Ontario property to the Daly Mine, lying on the west side of the Ontario and under the same management, the object of the tunnel being to drain this as well as the Ontario. In time it will probably drain the properties lying still farther west, and in the same mineral belt.

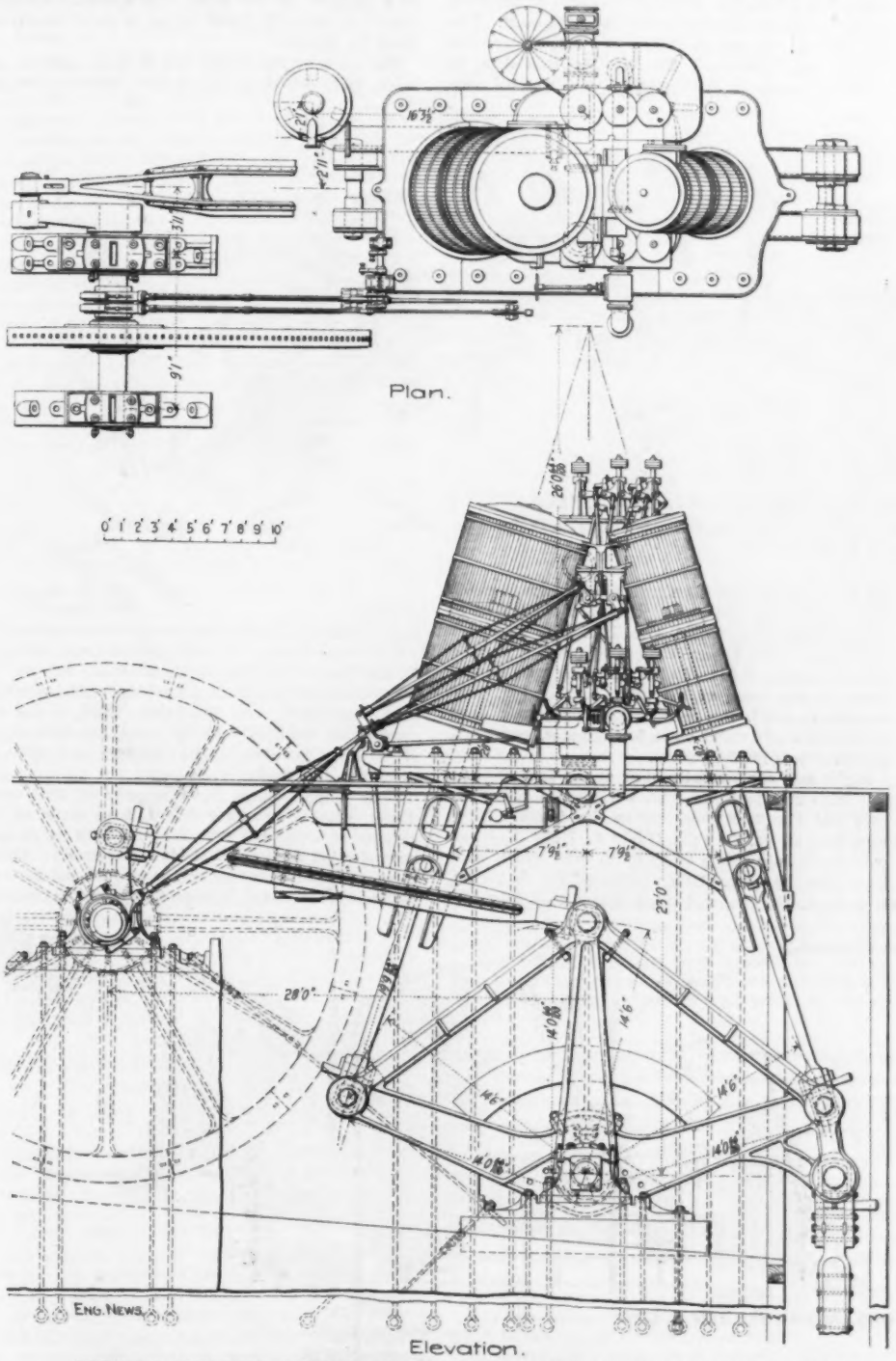
Perhaps no other tunnel that was ever driven in a rock formation throughout as this one has been has met such peculiar and unusual difficulties. Material was rock from the start—no earth at all. It was known from the mining operations that water would be the worst enemy to deal with. Through this whole region there are countless underground reservoirs where the rock formation is crushed. Work was begun at the east or outlet end on July 25, 1888, the workmen having moved to the ground on July 12, and it was then estimated that it would take four years for completion. Work was begun by hand, and 300 ft. was thus driven until Dec. 10 of the same year, when machinery was in position to aid. The first mile of the tunnel was in porphyry, which presented no great difficulties. From there on to about the 14,600-ft. mark, the work was in limestone with occasional bunches of porphyry; the rest of it to shaft No. 2 has been mostly a hornblende-biatite granite. The lime rock here generally alternates in hard and soft beds, a bed 30 or 40 ft. thick of the former being succeeded by a 50 to 100-ft. bed of the latter. These beds have a general dip of about 20° in direction of line of the tunnel, so a soft bed would take up 150 to 300 ft. of the length.

The hard beds were of the hardest crystalline structure and impervious to water. The soft beds were of crushed rock saturated with water. These beds are supposed to be continuous to the surface hundreds of feet above, and the hydrostatic or artesian pressure developed in the soft beds, being confined between the hard beds, was, of course, enormous. In addition to this, a fact which of course could not be foreseen added much to the difficulty of the work. Much of the tunnel was found to be nearly parallel with the main lines of dislocation, so that such a line once met would be followed a long time before being crossed and left.

For the first 6,000 ft. no serious difficulties were encountered. Then a fissure was tapped that poured forth a large volume of water, not sufficient, how-

ever, to stop the work, and which began diminishing after two or three weeks.

Soon afterward another fissure was tapped that flooded the tunnel, driving the men out and stopping work for 70 days. Then the underground reservoir, or pocket that chiefly fed it having been drained, it began diminishing. Nearly all these fissure flows that have been since struck have gradually dried up, though often taking a year or more to close, and always lasting two or three weeks, or



CORNISH PUMPING ENGINE AT ONTARIO SILVER MINE, PARK CITY, UTAH.
Designed by W. R. Eckart, M. Am. Soc. C. E., San Francisco, Cal.; Built by I. P. Morris & Co., Philadelphia, Pa.

longer, before beginning to noticeably decrease. Rapid progress was generally made in the hard beds and they required but little timbering.

The clear section of the tunnel was intended to be 8 ft. 8 ins. high by 4 ft. 6 ins. at the top and 5 ft. 6 ins. at the bottom, though the latter has usually been made as much as 6 ft. The floor of the tram track rests on 6 × 10-in. sills and is of 3-in. plank. The gage of the tramway is 18 ins. Once in every 1,000 ft., as nearly as possible, the tunnel is enlarged and a station or side track 156 ft. long is put in. The drainage channel for the water has an average width of 5½ ft. in the clear and an average depth of 1½ ft. below the floor of the tramway. No boxing, or flume, has been or will be used, the velocity not being enough to scour out the bottom.

A timber bent consisted of the sill, two batter posts and the cap, all 10 × 12 ins. or 12 × 12 ins. The section made for timbering usually averaged 11 ft. high and 9 ft. wide, a good layer of lagging being placed behind the posts, while poling boards were driven over the caps. While this was the standard bent, no set rules could be followed, but the method of timbering was varied to suit the ground. In some places, where the pressure overhead was particularly great, the roof was torn down so as to put in a second bent on top of the first—an inverted V bent with the feet of the batter posts on the cap of the first bent.

The distance apart of the bents was usually 4 to 5 ft. Bracing was used between, as blasting at the face tended to force the timbers back. In the soft beds timbering was kept close up to the face and 8-ft. poling boards were driven over the cap of each forward bent as placed, being driven forward and inclined upward so as to hold up the roof until the next bent could be put in. The poling boards were generally driven by hand, though it was very difficult and expensive, the great water pressure in front resisting it so that often a board would be repeatedly broomed and cut off without much headway. These poling boards were usually 3 × 6 ins. and of the best wood obtainable.

On one occasion (when about 11,000 ft. in) where it seemed impossible to drive in the sheeting by hand, one of the Ingersoll drills was brought into use. It was properly rigged up, the piston rod fitted so as to make a pile driver, the air pressure was got up to 85 lbs., and after the poling boards had been shod and capped with steel, they were driven home by this method. At this point it took no less than six weeks to advance 5 ft. and put in one set of timbers. Two weeks more were required to prepare for another set, and then it was found that the shoe of one of the poling boards was broken. It was a tremendous task to extract this, and its removal renewed the flow of water, so it took two weeks more to replace this and put in the set of timbers.

One of the first courses of water to be tapped came from a fissure extending nearly across the tunnel in a diagonal direction from top to bottom. The stream came out in a solid sheet, and, striking the opposite wall of the tunnel at an angle, was so deflected as to fly outward for over 100 ft. This was overcome by getting a large locomotive headlight and placing it just out of reach of the spray. This furnished enough light to enable men to go in and build a bulkhead to stop the flow across the tunnel while permitting it to run down into the drain.

In November, 1891, a body of water was tapped that sent forth a flood which tossed the men about like chips, covered the tramway to a depth of 13 ins., and tore loose and set floating all the air pipes. The estimated flow of this fissure was 13,000 gallons per minute. After waiting for five weeks for this stream to exhaust itself, the company sent East for three dozen rubber suits, at a cost of $13 per suit. These came up to the armpits of the men and had to be entered from the top. Dressed in these they waded in against the strong stream and raised the track 18 ins., to get it above the water. All this caused a delay of 70 days.

In a number of places side drifts were run to get around the flow of water encountered at the breast. These left the tunnel at right angles and then curved around and struck the tunnel line some distance ahead. Then the work would be carried backward toward the obstacle. It was necessary with these drifts to avoid an acute angle with the main line and to keep at a distance of some 50 ft. from it to avoid weakening the intervening pillar of crushed rock. These drifts served to divert the flow of water from the face of the main tunnel. From one of the first a cross-cut was driven to the main line to secure another point to work from.

It was found in all this ground that wherever excavation was going on, there the water was worst; and drifts and holes abandoned temporarily soon began to choke up with sediment carried by the water and would soon become dry. One important thing was to keep up an agitation of the ground at some other point than where the work was going on to divert the flow. In one place where a drift had been temporarily abandoned a number of holes were bored in the bulkhead of plank placed in its face and a man was then kept busy working a bar through these holes and stirring up the ground back of them, to keep it from puddling and to divert the water while work was going on in the face of the tunnel. In November, 1889, a cave-in occurred in the workings, and a side drift of 156 ft. length on each side of the tunnel was run to more effectually drain the ground and get the tunnel through. This caused a delay of three months. About 1,000 ft. of side-drifts were run in all. It was found that wood was about the poorest kind of material for packing behind lagging and over poling boards; but old clothes, sacking, etc., answered the purpose admirably, as they caused puddling and were elastic and gave the ground room to swell. The enormous pressure on some of the timbers reduced them from 12 ins. to 4 ins. in thickness.

Much trouble was had with "swelling" ground,

really only an effect of the water pressure. It was found impossible to put in any system of timbering strong enough to withstand some of these pressures, as the ground would force them in, either breaking them or distorting the bents and throwing them out of position. These bents had to be repeatedly eased by removing ground back of them. The strongest construction adopted was with 14 to 16-in. round posts. At one point the ground forced the timbers in from all sides leaving an opening not large enough to crawl through.

Whenever a soft bed of lime had been pierced the work would again go on smoothly, leaving the gushing streams of water to the rear. The worst of the streams were provided with a barricade or shield to deflect the water to the drain. The ground has all gradually drained off along the tunnel, so that where terrific pressures were encountered that delayed progress for weeks at a time, all is now perfectly safe, most of the flow having dried up or else coming in only at the bottom.

It goes without saying that driving this tunnel has been dangerous work, and only men of courage and endurance stayed with it for any length of time. There were not only torrents of water calculated to cause one to become panic-stricken, and falling rock to be watched for, but many times the timbers back from the face were cracking with a great noise as the running ground gradually forced them in, and the thought of being cut off from the rear was more terrifying than the dangers in front.

MAP OF UNDERGROUND WORKINGS OF ONTARIO MINE, JAN. 1, 1894.
(Different Levels are Distinguished on Original by Different Colors Corresponding to Different Colors on Profile.)

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It is gratifying to record that with all the dangers met in the six years of work but one man was killed while working in the tunnel. For this excellent record much credit is due to Mr. John H. Keetly, the superintendent of construction of the tunnel. It is to his courage, perseverance and skill that the company is greatly indebted for the successful completion of a most difficult and dangerous work.

The plant for driving the tunnel was an excellent one. At the mouth were commodious buildings for the different kinds of machinery and work.

Ample boiler capacity and engine power were provided and saws were run for cutting the timbers. A No. 6 Root blower (run at 150 revolutions per minute) was used as an exhauster to suck foul air out of the tunnel after blasts, through a 20-in. pipe, made of No. 16 galvanized sheet iron. A No. 4 Burleigh and a 14 × 22-in. Rand air compressor were used. The compressed air was conveyed into the tunnel through a 6-in. kalameined pipe. This supplied fresh air to the men after use in the drills, though the Root blower could be used for the same purpose.

In drilling at the face a horizontal bar was used, extending across the tunnel and wedged at the ends, with two 3½-in. Ingersoll drills mounted on it. The tunnel was, of course, driven full size on account of its small section. The blasting was done in sections, beginning at the bottom, and was all done by fuse, as battery blasting gave too much shock and did not suit the work. For each blast 8 to 16 1½-in. holes were drilled 3 to 5 ft. deep and each was loaded with 1½ to 5 sticks of powder, making a total charge of 40 to 50 lbs. Drilling was usually easy, though some of the time, notably for three months in 1893, the rock was so extremely hard that steel would stand but a few minutes, and 20 ft. per week was good progress.

Eight men constituted a shift at the face, four at the drills and four muckers, who loaded the tramcars and also took them out to the dump. These cars held 20 cu. ft. each (1,500 to 1,700 lbs.) and were made into trains of 10 to 15 cars, which were hauled by one mule. Other gangs did the timbering, laid the track, etc., and altogether it took 30 to 50 men to keep the work going day and night. Work in the tunnel was done on eight-hour shifts. It was foreseen from the first that it would be impossible to sink shafts to hurry this work. The ground over the line of tunnel was so saturated with water, to say nothing of the water tapped by the tunnel, that it could never have been handled in sinking a shaft, even at any expense. During 1893 a start was made from the bottom of shaft No. 2 to work east, but the water increased so fast that after 270 ft. were driven it was found that pumps could not handle any more, and work from No. 2 was consequently stopped. The great lime belt, which included most of the bad ground, is about 1,000 ft. in thickness, being overlaid by the Ontario quartzites. In driving the tunnel, from the mouth to a point 14,600 ft. in, there was little trouble from caving, and the same was true of the work on the short 270-ft. drift from shaft No. 2.

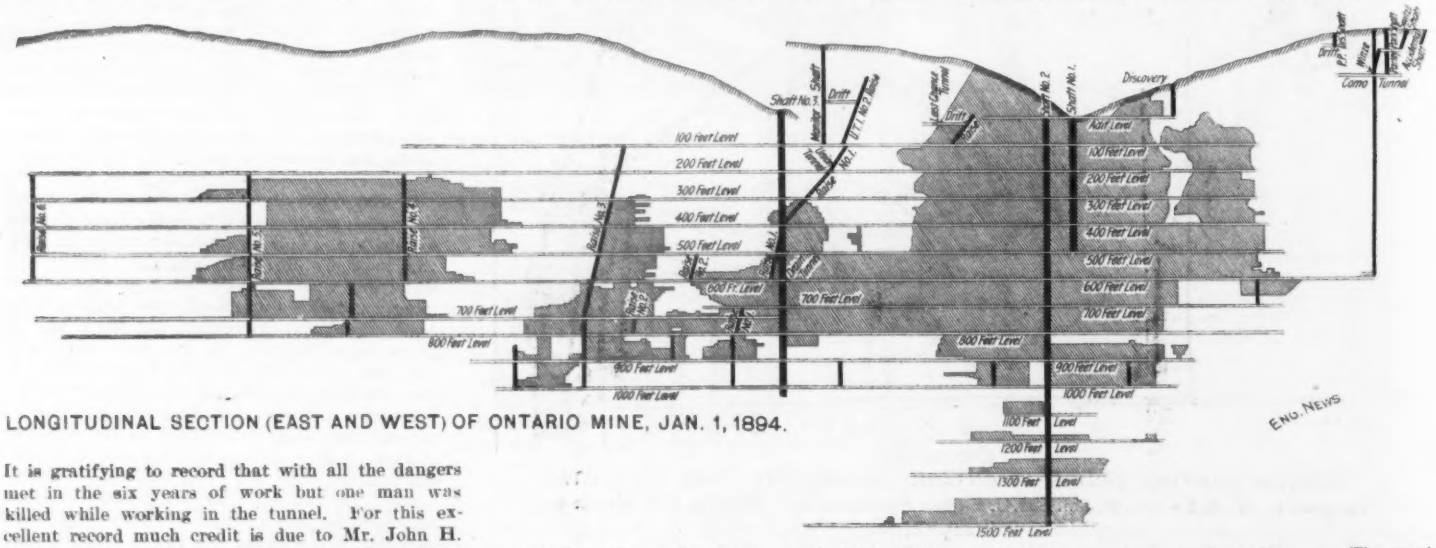
From the mouth the surface of the ground over the tunnel rises gradually, and is not over 1,000 ft. at a distance of one mile. The greatest elevation over the tunnel is 2,600 ft., at a point 12,000 ft. from the mouth.

The work on the tunnel has all been done by day labor, and, indeed, as events have shown, it would have been very hard to have secured any close bids for contract work. In good ground from 10 to 15 ft. has been an average day's progress; but, on the other hand, for weeks at a time no headway whatever was made. In November, 1890, a fire destroyed the machinery at the mouth, causing a loss of 60 days in time besides $30,000 in burned-up machines and tools.

Four single delays have aggregated 286 days. These, with other minor delays, have made an aggregate of over one year during which work has been stopped since the first blow was struck. Other delays, which did not entirely stop work but more or less impeded progress, have probably swelled the total of delay to nearly one and a half years. The greatest progress in any one month was 430 ft., in August, 1892. The greatest in one day was 21 ft.

By waiting for a flow to exhaust itself when struck, much labor and expense might have been saved; but time saving was so important that it was deemed best to keep at work and make whatever progress was possible.

In November, 1893, when the heading was within some 1,200 or 1,400 ft. of shaft No. 2, the first benefits of the tunnel began to be felt in a lessen-



LONGITUDINAL SECTION (EAST AND WEST) OF ONTARIO MINE, JAN. 1, 1894.

ing of the water to be pumped at both shafts. The flow was then about 3,200 gallons per minute, and this had decreased by Sept. 4, 1894, when 360 ft. was lacking to connect with the west heading, to 1,500 or 1,600 gallons.

It is not anticipated that the tram track (which will be left in place for maintenance purposes) will have to be raised, as the fresh reservoirs of underground water will be opened up gradually and successively as the levels are extended, and there will be time for one to drain off before another is struck. The flow when the water reaches up to the bottom of the tram floor is about 9,000 gallons per minute. During most of the construction the flow has averaged from 6,000 to 8,000 gallons. This water will probably become valuable in time, as ditches can be constructed leading from the outlet and covering some valuable irrigable lands at the head of the Provo River valley. As the fall of the gulch is rapid here, a goodly amount of water power can also be developed within a reasonable distance. The company has always kept in mind the possibility of making use of the tunnel for other purposes than drainage. The discharge of the old drainage tunnel is already utilized to some extent for power. The water is conveyed by a flume from the end of the tunnel to a point above the Marsac Mill in Park City. Part of it is used to supply the mill, while part is used under 148 ft. head to drive a 6-ft. Pelton wheel, and the power thus obtained is partly used for lighting the Ontario Mill and Mine.

The east and west headings of the tunnel met on the night of Sunday, Oct. 7, 6 years, 3 months and 12 days after the date of beginning the work. The line and level of the two headings checked excellently. The line of the tunnel was located by triangulation, but the center line was run over after being established to ensure its correct alinement. The levels were carried around by way of the main roads and gulches from the mouth of the shaft to the tunnel portal.

The total amount expended on the tunnel up to Dec.31, 1893, was $384,064, or an average of $27.75 per lin. ft., the total distance then completed being 13,840 ft. The total cost of the tunnel will probably be about $425,000. The Daly Mining Co. pays one-half of this cost. That the tunnel will amply pay for itself there seems little doubt, as large bodies of ore can now be reached and worked with little trouble from water.

The tunnel as it now stands will drain all workings of the Ontario, Daly and Daly West properties above its level. The great Cornish pumping engine will be left in place for use when it is desired to deepen the Ontario below the 1,500-ft. level, which will probably not be for a long time to come. The steam pumps will be taken out. The headquarters of the Ontario Mining Co. are at Salt Lake City. Mr. L. P. Haggin is President, Mr. R. C. Chambers is Superintendent, and Mr. James D. Murdock is the Engineer in charge of machinery.

SEWAGE PURIFICATION IN AMERICA.

(Continued from p. 422.)

Results in 1893 at the Lawrence Experiment Station.

The sixth year's work at the Lawrence Experiment Station on the purification of sewage is described by Mr. Geo. W. Fuller, Biologist-in-Charge, in the report of the Massachusetts State Board of Health for 1893.

The general scope of the work at Lawrence is now so well known and has been described so fully in past numbers of this journal* that it is necessary to present at this time little more than Mr. Fuller's admirable conclusions regarding the various phases of sewage purification by means of intermittent filtration.

First, it may be stated that average analyses of the sewage treated in the Lawrence experiments show it to be stronger than that applied to the sewage beds at Framingham, Marlborough, Gardner and Westborough. In other words, it contains more sludge, and, therefore, has a greater tendency to clog the filter beds, and, in general, is more difficult to handle than the sewage at the places named. This statement is made because it has been claimed that the sewage treated at the Experiment Station was weak, owing to the fact that it is pumped through a 2½-in. pipe, 4,300 ft. long, from one of the city sewers to the station.

The work of previous years has determined that with suitable filtering material 90% of the organic matter may be removed from sewage when filtering at the rate of 100,000 gallons per acre per day. Putting this in another way, one acre of land will fairly purify the sewage from a population of 1,000, assuming that 100 gallons of sewage per capita reaches the disposal area. But how long can a filter do such work and what can be done to prolong its life? Practically, the experiments seem to show that all but the upper 6 ins. of the filter can be used indefinitely, while this upper layer requires agitation and finally renewing, in order to keep up its efficiency. We may, therefore, compare a sewage filter bed to a street pavement, laid according to modern practice, the upper 6 ins. of the filter corresponding to the wearing surface of the pavement and the remaining depth to the permanent foundation. The upper layer of the filter, like the wearing surface of the pavement, may be completely renewed many times during the life of the substructure.

As this fact—that the lower layers of a sewage filter do not become charged with organic matter even with years of use—is one of much importance and value, we quote Mr. Fuller's statements concerning the results of the experiments made to test this point:

(1) The only filters in which there was a continued storage of nitrogen were the three which represent the extreme limits in the size of materials and the results with these are explained by the fact that there was an insufficient amount of air for the complete oxidation and nitrification of the applied sewage. From this it follows that the permanency of sewage filters is independent of the size of material, but is directly dependent upon the treatment which they receive.

(2) The removal of large amounts of stored organic matter in the spring and early summer months, under favorable conditions, is one of the most marked characteristics of sewage purification by intermittent filtration.

(3) In several cases the storage of nitrogen during the winter months was very slight, while in some instances there was a removal. This is not apparent from the degree of purification of the corresponding effluents, in which the free ammonia was very high, and this seeming discrepancy is explained by the fact that while freezing winter weather interferes with nitrification it does not seriously affect the oxidation of carbonaceous matter to free ammonia.

(4) The average results from all the filters, some of which have been in operation regularly for six years, indicate that there was practically no more nitrogen stored in the filters at the end than at the beginning of the year. From this it appears that, with the main body of the sand the same, sewage filters may continue to purify sewage for an indefinite time provided they receive proper treatment to insure sufficient ventilation for the oxidation and nitrification of the applied sewage.

Turning now to the treatment required for the upper layer of filters to preserve their efficiency, referred to in the last sentence of the quotation, the various means to this end are named and the conclusions regarding their efficiency are thus given by Mr. Fuller, in the quotation below, the term "scraping" indicating the removal of clogged material, and "trenching" being intended to designate the digging of a trench in the filter bed and filling the same with a different material:

(1) Systematic raking, with occasional harrowing or plowing, is very satisfactory, particularly for coarse materials.

(2) Systematic scraping at regular intervals (followed by raking to loosen the material) gives very good results, especially for fine materials.

(3) Systematic scraping when necessary, without raking or harrowing, is not advisable.

(4) The efficiency of very fine material (clogged or not clogged) is much increased by trenching with coarse material.

(5) Such trenches should contain carefully-graded materials at the bottom to prevent clogging at the junction of the coarse and fine sand.

(6) When new material is put onto old to replace clogged material removed by scraping, it is always advisable to mix the old and the new together in order to prevent clogging at the junction of layers of unlike capillary attraction.

(7) The removal of stored organic matter by resting for a limited period is sufficiently great to render this simple and inexpensive method worthy of careful consideration in cases of clogging where the available area is not too limited. It may be mentioned here that the depth of material necessary to be removed from the surface of several of the experimental filters would doubtless have been considerably less if they had been allowed to rest for a short time.

(8) It is important that the treatment of filters be such that the conditions of operation be as favorable as possible during the cold winter weather.

(9) Great care should be taken, especially in the case of filters of fine material, that the capacity of the filter be not taxed during the winter months to such an extent that more organic matter is stored throughout the sand than can be removed during the spring and early summer, which is the period of highest nitrification.

As the successful operation of a filter depends so largely upon the oxidation of organic matter on or within the upper layers of the sand, it is evident that the "life" of this upper layer, and also the quantity of liquid it can purify, may be increased if some of the organic matter is removed from the sewage before it flows onto the beds. This is done at some disposal areas, the most common methods being sedimentation and chemical precipitation, although where the latter is employed it is more often considered as the primary and filtration as the secondary means of purification. Screening is often employed, but seldom, if ever, to remove anything but the coarsest materials. At Lawrence fine screens have been tried, but not long enough to warrant drawing conclusions. Rapid filtration through gravel has been experimented with at Lawrence, supplemented by drawing a current of air through the tank. This method, simple sedimentation and chemical precipitation, are reported on by Mr. Fuller. The gravel filters were 65 ins. deep, and contained material of an effective size of 5.1 mm. (0.2 in.). The air was drawn through them by means of aspirators attached to the bottom of the tanks, the outlets being trapped. The sewage treated chemically, received alum at the rate of 1,000 lbs. per 1,000,000 gallons, or 7 grains per gallon, after which it settled four hours. Four hours was also the time allowed for the sewage which had simple sedimentation. Three filters 5 ft. deep and with material having effective grains of 0.17 to 0.10 mm. (.0066 to .0074 in.) were employed, one for each kind of sewage treated as described.

With rapid filtration through coarse gravel, supplemented by an aspirator, and with subsequent filtration in the ordinary way, 95.5% of the organic matter, as represented by albuminoid ammonia, and 99.8% of the bacteria were removed, the 95.5% of organic matter removed being divided into approximately 75 parts removed by the first and 20 parts by the second process.

By chemical precipitation and subsequent filtration 94.6% of the organic matter and 99.2% of the bacteria were removed, but the work done here was divided into 52.4 parts by precipitation and 42.2 parts by filtration. By sedimentation and filtration 91.3% of the organic matter and 98.8% of the bacteria were removed, but most of this work was done by filtration, sedimentation removing only 18.2 out of 91.3 parts of organic matter and 12 out of 98.8 parts of bacteria. The experiments with sedimentation, it should be said, covered only the three months from Oct. 1 to Dec. 31, inclusive, against the full year for the others.

Coming now to the rates of filtration of sewage previously treated by different methods, it was found that the sewage which had passed through the coarse gravel filter, with aeration of the gravel, was finally filtered at the rate of 819,900 gallons per acre daily; the chemically-treated sewage passed the filter at the rate of 267,200 gallons, and that which had been settled, merely, at the rate of 416,300 gallons, the latter being for the last three months of the year only. For this short period, however, the other two filters did better work than for the whole year, the filtration of the filtrate from the gravel proceeding at the rate of 960,000 and of the chemical effluent at the rate of 554,000 gallons per day.

Mr. Fuller's summary and conclusions on the subject of removing some of the sludge to prevent the clogging of the filter beds are as follows:

(1) Of the three methods given above for the removal of sludge, filtration through coarse gravel at a very rapid rate, and with the aid of a current of air drawn through the gravel, gave the greatest purification. Furthermore, it has the advantage that it burns up the

* See Eng. News, July 11, 1891, Dec. 15, 1892, and Sept. 28, 1893, for accounts of the work of previous years.

sludge to a large extent and does not call for additional means for sludge disposal.

(2) The removal of sludge by sedimentation enables filters of fine material to be operated at higher rates than filters which receive ordinary sewage. It appears that it would be advisable to employ sedimentation in many large filters where the sewage is strong and the filters are not cultivated.

(3) The aid received from the removal of sludge by chemical precipitation does not appear to be sufficient to justify the additional cost.

(4) Of the three filters of fine sand which receive sewage from which the sludge has been partly removed by different methods, No. 12 A—(to which the sewage filtered through aerated gravel was applied.—Ed.)—received the best purified sewage and gave the highest efficiency both from a qualitative and a quantitative point of view. This filter also is the only one capable of continuing to work at the rates given above.

(5) Upon studying the several methods of obtaining a well-purified effluent from sewage, we find that the average rate of filtration for the combined area of the two gravel and the one sand filter was 320,000 gallons per acre daily for six days in a week. This is the best result yet obtained with the experimental filters, and this system of double filtration with the aid of a current of air appears to be capable of application to the purification of sewage on a large scale.

In considering the above deductions it must be borne in mind that local conditions would often decide which method of sludge removal should be employed, or whether it was worth while to use any method. With plenty of cheap land and with cheap labor it might be advisable to depend wholly upon filtration, possibly supplemented by sedimentation to a greater or less extent, or by the most efficient screens which could be devised. With more costly land and labor, sedimentation might be still more desirable, its availability in any case, as well as the availability of chemical precipitation, and double filtration, with aeration, depending upon whether the lay of the land necessitated pumping, or perhaps extra pumping, to make the method in question possible. The character of the filtering material at hand would also be an important factor in this connection. On the basis of the figures for the whole year, about 20% more land would be required for combined chemical precipitation and filtration than for aerated gravel filtration and subsequent sand filtration combined. The cost of constructing and operating precipitating tanks, including the purchase of chemicals and the treatment of sludge, is to be compared with the cost of constructing air pipes and pumps and drawing air through the gravel.

One of the first methods, if not the very first, employed in this country to purify sewage was by sub-surface application at Lenox, Mass. This system has been tried on a small scale at hundreds of places since, almost wholly for private dwellings and public institutions. From experiments with sub-surface irrigation in a tank at Lawrence and from observations at the Lenox town disposal works and at the disposal area of Wellesley College, Mr. Fuller submits the following conclusions, with which we conclude our review of his report:

(1) From a chemical and biological point of view no marked difficulties attend the purification of sewage applied beneath the surface.

(2) As much of the sludge as possible should be removed from the original sewage by screens and sedimentation before applying it to the sub-surface.

(3) The sub-surface pipes should be provided with outlet gates at the lower end, opposite the point of application, so that they may be flushed out from time to time to remove the accumulated sludge.

(4) In most cases, to avoid clogging, the drain pipe should be surrounded with stone or coarse gravel, and in order to prevent the sand from filling the spaces the gravel should be surrounded with successive layers of material of intermediate and gradually decreasing size.

THE MAXIMUM PRACTICABLE LENGTH FOR SUSPENSION BRIDGES.

(Continued from p. 425.)

Bracing.

The bracing required to stiffen the bridge may be conveniently considered under two heads, vertical bracing and lateral bracing.

1. Vertical Bracing.—It is the object of this bracing to confine within definite and small limits the oscillations and deflections caused mainly by the rolling load. Various methods have been employed for this purpose, the principal of which are as follows:

(1) Stays extending from the tops of the towers to the platform.

(2) Stays extending from the bottoms of the towers to the cables.

(3) Longitudinal stiffening girders connected with the platform and extending over the whole length of the bridge.

(4) Bracing between two cables hanging in the same vertical plane.

(5) Trussing the cable on its concave side.

(6) Trussing between the cable and the platform.

Two or more of these methods of stiffening are frequently employed together in the same bridge. For example: Methods (1) and (3) are employed at the East River Bridge; method (3) at the Niagara Bridge; method (4) at the Allegheny River Bridge at Seventh St., Pittsburg; method (5) at the Point Bridge over the Monongahela at Pittsburg; method (6) at the Lambeth Bridge, England. Experience has proved all these methods to be effective, and for some of them special advantages of economy are claimed. Thus the over-floor stays of method (1) not only prevent the development of large vertical oscillations in the platform, but also relieve the suspension cables of a considerable part of the load. In method (2) the stays add to the weight on the cables instead of relieving them, and in this respect it is not as good as method (1). It has been objected, however, to the use of stays in bridges of large span that they complicate the conditions of equilibrium, as it is difficult to adjust them so as to bear a definite portion of the stresses under the varying conditions of load and temperature. By bracing two cables—method (4)—we utilize the cables as the chords of the stiffening girder and save the material otherwise required for the chords. Still greater economy is claimed for combinations of the stiffening systems.

The simplest and most employed stiffening system is the longitudinal stiffening girder. Such girders are convenient for supports to the lateral bracing and for side guards, and at none of the existing bridges where other methods were employed was the girder entirely dispensed with as a part of the stiffening system. The girder rests upon the floor beams and is thus suspended from the cable. It does not support any load, but merely distributes it, hence it is absolutely a dead weight, adding nothing to the strength of the bridge.

The Board consider it very probable that for a given special case a lighter and better stiffening system than that supplied by the simple longitudinal platform girder could be worked out by combining the trussed cables and longitudinal girder systems, as has been done by Mr. Gustav Lindenthal in his elegant design for the North River Bridge. In applying this method, however, to wire cables carrying very heavy weights over a very long span some new questions of constructive detail will require solution, and for the purposes of a general investigation it seems best to follow the usual method of stiffening. It will, therefore, be assumed that vertical stiffness is obtained entirely by longitudinal platform girders with parallel chords. These girders are usually of the open frame or lattice type. While their rigidity does not affect the actual safety of the cables which carry the entire dead and live load, it does determine the suitability of the bridge for railroad purposes. There is no doubt that a suspension bridge can be made as rigid for railroad trains as a bridge of any other system.

If a flexible cable be loaded uniformly it will be depressed on the side of the heaviest load and will rise on the opposite side. It is the object of the stiffening girder to reduce the distortion of the cable to a practical minimum. There are two practical ways in which the girder may be constructed:

(1) As a continuous girder, loosely supported at the ends with reactions in both vertical directions, but permitting horizontal motion.

(2) As a girder loosely supported at the ends, as in the first case, and hinged in the middle.

For the first case the problem of equilibrium is statically indeterminate; that is, the conditions of equilibrium cannot be formulated without including the elastic forces developed in the girder. In the second case we have only to deal with static forces, and the stresses in the girder can be calculated with a close degree of approximation by the simple law of the lever.

In the designing of stiffening girders the formulas given by Professor Rankine have generally been employed. The formulas for the continuous girder are deduced in his "Applied Mechanics" (p. 370). The formulas for the hinged girder are given, but not deduced, in his "Civil Engineering" (p. 579). Rankine's methods, which are approximate in character, have been extended to a high degree of accuracy by subsequent investigators. Probably the most complete investigation of the straight stiffening girder is that of Prof. J. Melan, of the Technical High School at Bruenn.

Rankine's values of the maximum bending moments for the hinged and continuous girders are as follows: Hinged girder, $M = 0.0156\ q\ L^2$; continuous girder, $M = 0.01786\ q\ L^2$; while Melan, by more accurate methods, obtains for the hinged girder, $M = 0.01883\ q\ L^2$, and for the continuous girder, $M = 0.01632\ q\ L^2$. It will be noticed that with Rankine's values the maximum bending moment is smaller for the hinged girder than for the continuous girder, while with Melan's values the reverse is the case.

Although the hinged girder presents very decided theoretical advantages, especially in the determination of the stresses, it has some disadvantages which have prevented its employment in any important practical case. The introduction of the middle joint has for its principal object the attainment of a static determination, but, as Melan has pointed out, the theoretical conditions cannot be fully satisfied unless the girder and cable have a common joint at the middle. If the girder alone is jointed, increased bending strains must be produced in the cable directly over the joint. The arrangement of the wind bracing becomes more troublesome, for, since the upper chords of the girders are cut, all the wind stresses must be transferred to the lower chords. The wind bracing would doubtless be heavier than for a continuous girder.

Mr. Lindenthal has shown that while there are no temperature stresses in a three-hinged arch at the middle hinge they do exist for any change from the normal temperature in the connected half-arches. His investigation of this important question (which originally appeared in the Engineering News of March 10, 1888, and which has been revised by him for the Board) will be found in Appendix D. For the purposes of this investigation, however, there is no question that the hinged girder ought to be adopted, in order to avoid the complicated formulas which would be required in the other case. It will give results as accurate as the nature of the inquiry permits and on the safe side as regards weight of metal, which could be considerably reduced for any given case in practice by the use of continuous girders, or by other methods requiring more extended computations. The New York Board employed the same method.

It will appear hereafter that when considerable rigidity is required, as in railroad bridges, the stiffening truss becomes the greatest single element of weight and therefore its economical designing is a matter of the highest importance. The Board therefore appends to this report a translation of Professor Melan's complete investigation of the straight stiffening girder, which it is believed is unknown to most American bridge engineers. A simpler investigation, but sufficiently rigorous for all practical purposes, covering both the hinged and continuous girders, has been attached by the New York Board as an appendix to its report.

In the case of the hinged girder the greatest distortion of the cable occurs when the moving load covers the platform from one tower to a point at a distance 0.105 L from the middle of the bridge. It is here assumed that there will be practically no temperature strains and the simple statical conditions will enable us to express with sufficient accuracy the weight of the girder in terms of the span.

The values of the bending moments and shears which will be used in determining the weight of the girder are based upon the following assumptions:

1. The stiffening girders are supposed to have a height sufficient to prevent great vertical flexure. So far as the vertical strains due to loading are concerned it is most economical to make the height as great as is practically possible, and with the hinged girder this may may be done, since changes of temperature are without material influence. The height of the girder will therefore be assumed at 120 ft., as adopted by the New York Board.

2. The tensions on the suspenders are supposed to be always equal; that is, the vertical reaction between the cable and the girder is uniformly distributed over the whole length of the span; and the tensions on the cable are assumed to be invariable. It has been shown by M. Boulogne* that in the case of the suspenders the values obtained on this hypothesis cannot be in error more than 5%, and for the cables the error is on the safe side, since it increases the amount of work required of the girder.

3. The effects of the elastic elongation of the suspenders, due to live load and temperature changes, are neglected. As remarked by the New York Board, these disturbances can be avoided by omitting the suspenders for a short distance next the towers.

The discussion of the values of the maximum bending moments and shears is omitted from this report, as it is given fully in Melan's investigation (Appendix E), and also in Appendix E to the report of the New York Board.

The curve of maximum bending moments covering the half girder, whose length is ½ L, is very nearly a parabola, and its area is very nearly $\frac{2}{3} \times \frac{L}{2} \times 0.01883 q\ L^2$.

The average maximum bending moment will therefore be:

$$M_m = 0.01255\ q_1\ L^2.$$

The average maximum chord stress is found by dividing this moment by the height of the girder; the area of the cross-section of the chord in square inches

* Note sur les Ponts Suspendus, Annales des Ponts et Chaussees, 7 Serie. Tome 1, 1892, p. 742.

is obtained by dividing this chord stress by the assumed working unit stress; and the theoretical weight of the chord per linear foot by multiplying his area by 3.4 lbs. To obtain the practical weight the theoretical weight must be increased by about 25% for constructive details. Although the chords are subject to reversal of strains, the Board have assumed a unit working stress of 15,000 lbs., for reasons which will be fully explained elsewhere.

The weight of the upper chord in pounds per linear foot will therefore be:

$$\frac{0.01255\ q_1\ L^2 \times 3.4 \times 1.25}{15.000 \times 120} = 0.0000002963\ q_1\ L^2.$$

The dimensions of the lower chord will have to be considerably increased, as it serves also as a chord in the wind girder. Assuming, for computation, a wind pressure of 2,250 lbs. per lin. ft. for reasons before given, the average maximum bending moment due to the wind will be:

$$M_{mw} = 187.5\ L^2.$$

The unit working stress will be assumed at 30,000 lbs. per sq. in. for reasons which will be given elsewhere. Remembering that the width of the track platform between the axes of the girders is 100 ft., we obtain for the weight per linear foot of material to be added to the lower chord to take care of the wind stresses

$$\frac{187.5\ L \times 3.4 \times 1.25}{30,000 \times 100} = 0.0002656\ L^2.$$

The average total weight per linear foot of the lower chord is therefore

$$(0.0002656 + 0.0000002963\ q_1)\ L^2.$$

The shearing stresses due to a continuous moving load are greatest at the origin of the span and diminish to 0, changing from upward to downward stresses at a distance $\frac{L}{4}$ from the origin. The average maximum shear without regard to sign for all positions from the origin to the middle pin is $S = q_1\ L$.

The theoretical weight of the web must be increased by about 50% for constructive details and to provide for the transfer of weight from the upper to the lower chord. The lattice bars being placed at an angle of 45°, the weight of the web per linear foot of span will be

$$\frac{0.19381\ q_1\ L \times 3.4 \times 1.5 \times 2}{15,000} = 0.00007058\ q_1\ L.$$

For the total weight per linear foot of each stiffening girder we finally obtain by addition

$$\frac{p_2}{2} = q_1\ (0.00007058\ L + 0.0000002926\ L^2) + 0.0002656\ L^2.$$

The value of q_1, which is to be employed in this formula, must now be determined. It will be remembered that the stiffening girders carry no weight, not even their own. They simply distribute the inequalities of the live load and limit the deflections in the cables and floor system. The girders must be dimensioned with special reference to those positions of the live load which correspond to the greatest deflection. The maximum bending moment in either half-girder corresponds to a continuous live load extending from the origin towards the middle of the span and covering a distance 0.395 L. For all spans up to 2,957 ft. (equal to the maximum train length divided by 0.395), the single freight train on each track (all six trains being supposed to advance together with their engines abreast) will produce the maximum bending effects, the length of such a train being 1,168 ft. For greater spans it is evident that the maximum effect will not be thus produced. Accordingly, for spans greater than 2,957 ft. we should divide the maximum train load by 0.395 L to obtain the live load per linear foot of span to be used in determining the weight of the stiffening girders.

The weight of the train is 3,060,000 lbs.; hence for each girder we obtain

$$q_1 = \frac{3060000 \times 3}{0.395\ L} = \frac{23240506}{L}$$

and by substitution in the preceding equation

$$\frac{p_2}{2} = 1640.3 + 1.377\ L + 0.0002656\ L^2.$$

The total girder-load per linear foot for the whole bridge will therefore be $p_2 = 3281 + 2.754\ L + 0.0005312\ L^2$.

This formula leaves entirely out of consideration the fact that part of the live load is taken up directly by the cables, yet it is certain that a considerable part of the action of the live load may be thus absorbed. In his reconstruction of the Niagara Suspension Bridge, Mr. L. L. Buck, the engineer in charge, provided for a maximum deflection of 15 ins. in 500 ft. and thus reduced the value of $2\ q_1$ in his formulas from 0.8 ton to 0.6 ton. Mr. W. Hildenbrand, in his reports relative to a proposed suspension bridge across the Hudson River, which are appended to the report of the New York Board, provides for a maximum deflection giving a grade not exceeding 1%. He thereby reduces $2\ q_2$ from 9,000 lbs. to 7,800 lbs. The Board do not doubt that within narrow limits a certain degree of flexibility is an advantage to the bridge. Deflections in a system of stable equilibrium do not impair the safety of the structure as they do in an unstable system like the upright arch, and they may exert a very beneficial influence in modifying the dynamic effects of a rapidly-varying live load. On the other hand, it is to be remarked that any increase in the grade of the track-platform is accompanied for fast trains by a certain increase in the dynamic action of the live load.

The proportion of live load absorbed by the cables increases as the catenary becomes flatter, but the cables must be made heavier. It is not easy to determine satisfactorily the resultant effect of these deflections, and in order to be on the safe side the Board make no allowance for them in this investigation.

Lateral Bracing.—The principal duty of the lateral or sway bracing is to resist the action of the wind. The top lateral system is a light riveted latice connecting the top chords of the stiffening girders. Since these chords are cut at the middle, the entire work of resisting wind pressure is done by the bottom lateral system. The top system, in conjunction with the cross-frames and hangers in a vertical plane above each cross-girder, serve simply to transfer the wind stresses and a portion of the load to the bottom system. We may assume for the weight of the top system 500 lbs. per linear foot, and for the cross-frames and hangers, 1,920 lbs. per linear foot, as computed by the New York Board. These weights may be considered constant for all values of the span within the limits of this investigation.

In the bottom system the chords are the bottom chords of the stiffening girders, in the dimensioning of which the wind stresses have already been provided for. The cross girders of the floor system form the lateral struts, and the diagonals are strained in tension. It only remains to determine the weight per linear foot of the diagonals. The depth of the wind-girders (d) is 100 feet, and the theoretical panel length (b) is 120 feet. The number of panels (n) on each side of the middle point is therefore $\frac{L}{2\ b}$. The theoretical panel load is 2,250 b; the assumed unit stress is 25,000 lbs.; and 25 per cent. is added for constructive details. The weight of the diagonals per linear foot of span will then be

$$\frac{2 \times 1.25 \times 3.4 \times 2250\ b\ L^2\ (b^2 + d^2)}{25000\ d\ L \times 4\ b^2} = 0.3889\ L$$

For the weights in pounds per linear foot of the lateral or sway bracing, including the cross-frames and hangers, we therefore have $p_3 = 2420 + 0.3889\ L$.

Working Stresses.

In determining the weights of the two most important members of the bridge—the cables and the stiffening girders—the Board have assumed working stresses which are greater than those generally adopted in truss or arch bridges of moderate span, and which, therefore, require explanation.

The most approved formulas for the determination of working stresses are based upon the experiments of Herr Woehler, made for the Prussian Ministry of Commerce, and published at Berlin in 1870.* These experiments not only confirmed the earlier result obtained by Sir W. Fairbairn and others, that with repeated applications of a load a bar breaks under less than its static breaking load, but they also showed that the breaking load varies inversely with the difference between the maximum and minimum stresses. Furthermore, it was found that a bar may be broken by a still smaller fraction of the static breaking load if it is alternately strained in opposite directions, the stress alternating between a positive and a negative quantity.

The principal formulas representing these results are based upon two radically different interpretations of the observed facts. In one case it is assumed that the repeated alternations of stress produce an actual weakening of the material, which has been called "fatigue." This view is represented by the Launhardt-Weyrauch formulas, which are as follows:

For stress in one direction—

$$a = u\ (1 + \frac{t - u}{u}\ \phi)$$

For alternating positive and negative stresses—

$$a = u\ (1 - \frac{u - s}{u}\ \phi)$$

in which $\phi = \frac{\text{min. } s}{\text{max. } s}$ = the ratio of the least to the greatest stress; a = breaking strength under the assumed conditions, which is to be divided by the factor of safety (generally 3); t = breaking strength under a static load; u = the limiting strength (Ursprungsfestigkeit), measured by the greatest load the bar will bear with an indefinite number of alternations between 0 and u without reversal; and s = vibration-resistance, which is the limiting strength for alternations of equal magnitude with reversal.

*Ueber die Festigkeitsversuche mit Eisen und Stahl.

In the other case it is assumed that the alterations produce no change whatever in the molecular condition of the material, but that the increased effects are produced entirely by an increase in the stresses due to dynamic action, the stress being equal to the load only when all the forces acting are in static equilibrium. This view is represented by the Launhardt-Weyrauch formula, which is

$$a = \text{max. } S + \eta\ (\text{max. } S - \text{min. } S).$$

In this formula η is a coefficient depending upon the violence and time-rate of the load-changes.

The Launhardt-Weyrauch formulas are based entirely upon Woehler's experiments, and do not take into consideration variations in the rate or violence of the dynamic action. Prof. Fidler says that in these experiments the load was applied about four times per minute.

Prof. Fidler has shown that when the alternations are rapid (for which case $\eta = 1$) the dynamic formula represents Woehler's experiments as accurately as the Launhardt-Weyrauch formulas. No satisfactory determination, however, has been made of the value of η for the various cases occurring in practice. In the case of cross-girders and vertical suspenders, which receive the full action of the elastic vibrations due to a sudden imposition of the load, Prof. Fidler assumes $\eta = 1$, and he adopts the same value for the diagonals of the web bracing. For the flanges of a girder, or in the principal members of an arch or suspension bridge, in which the stress-changes take place more gradually, he recommends a reduced value bearing some unknown relation to the length of span. He considers the value $\eta = \frac{1}{2}$ to be large enough for all spans down to about 100 ft.

It is not possible in this report to make an extended comparison of the merits of these formulas. It may be remarked, however, that the effects of variations in dynamic action certainly play an important part in the determination of ultimate strength, although there are as yet no experiments showing how far this strength is affected by the frequency as distinguished from the mere number of the stress-changes, nor whether a period of rest after "fatigue" restores strength. These effects of dynamic variations, which are entirely unrepresented in the Launhardt-Weyrauch formulas really exist, and are of special importance in the theory of suspension bridges. A clear and able discussion of the whole subject will be found in Chapter XIII. of Prof. Fidler's "Practical Treatise on Bridge Construction."

The Board have adopted for the cables a working stress of 60,000 lbs., which is one-third of the static breaking load. Prof. Melan says that, owing to the lack of experiments with steel wires, we can consider the laws of Woehler only as far as to allow for large spans a somewhat greater value of the working stress. For ordinary spans he adopts a working strength of about one-fourth the ultimate strength of the wire. The Board believe that a safety factor of 3 is amply sufficient to cover both the effects of variations in stress and the imperfections of manufacture and adjustment in the cables. As regards variations in stress it is to be remarked that there are no reversals, the wire being always in tension; that considerable deflections correspond to relatively slight changes in stress; and that the stresses are slowly and gradually applied, and well within the high elastic limit.

This later point is of special importance, for it is probable that Woehler's law of reversals does not hold good for stresses well within the elastic limit. For example, in the balance spring of a watch, tension and compression succeed each other some 150,000,000 times in a year, and the spring works for years without apparent injury.* In this connection it may be remarked that, although cables which have been long in use have been frequently examined, no deterioration of strength which could be attributed to variations of stress has ever been discovered. If we use the Launhardt formula, we are justified in making u very nearly equal to t.

If we employ the dynamic formula, the factor max. S — min. S will be very small, for the reasons just given. As for the coefficient η, we only know that it diminishes as the span increases, and, according to Prof. Fidler, it need not be greater than ½ for a span as small as 100 ft.; it must therefore be a very small fraction for spans as large as those now under consideration. The variation-term of this formula will probably be so small that it may be safely neglected.

As regards imperfections of manufacture and adjustment, which are covered in general practice by the safety factor 3, the following points are to be noted. The uniformity of strength is greater for wire than for any other form of steel. The process of manufacturing a wire cable is in itself a test of the material, and insures a more nearly uniform distribution of stress over

*Prof. Ewing, Strength of Materials, Enc. Brit.

the cross-section than can be obtained in any other structure formed of a very great number of parts. If a factor of 3 is sufficient to cover the defects of material and construction of a riveted bridge-member, a somewhat less factor ought to be sufficient for a wire cable.

For the reasons above given, the Board are of the opinion that a safety factor of 3 is sufficient, and have therefore adopted 60,000 lbs. per sq. in. as the working stress for the cables. The New York Board adopted the same working stress, giving as their reason that this is "the same proportion of the ultimate strength that the 20,000 lbs. adopted in the cantilever structure bears to the probable strength of eye-bar steel." The Board have adopted 15,000 lbs. per sq. in. for the working strength of the stiffening girders. The New York Board limited the stresses due to a moving load to 12,500 lbs., because there is a reversal of strains, but allowed the stresses from the combined effects of moving load and wind to run up to 22,500 lbs. The reasons of this Board for adopting a higher working stress in the stiffening girders are as follows:

Although there is a theoretical reversal of strains, it will rarely and perhaps never occur with the maximum stress, since this would require six of the heaviest freight trains, abreast of each other, to cross and recross the bridge, first in one direction and then in the other. This would probably never happen on a bridge devoted principally to passenger traffic, and it could be prevented by the simplest police regulations. Again, the lower chords of the girders have been made of sufficient strength to resist the combined maximum stresses of the live load and the wind; but the maximum chord stresses could never occur at the same time, since with the maximum wind pressure no trains could cross the bridge. Some allowance has been made for this by the adoption of a working strength of 30,000 lbs. for that part of the material added to resist wind. The only duty of these girders is to distribute the live load and thus prevent inconvenient deflections. It is not necessary to give them the margin of strength which they would require if they were essential to the stability of the bridge.

The Board are of the opinion that the great distinction between the stable equilibrium of a suspension bridge, which cannot break down from the failure of any stiffening member, and the unstable equilibrium of a truss arch, or cantilever bridge, in which the failure of a member may involve the collapse of the entire bridge, ought to receive full recognition in the adoption of unit stresses and safety factors. The weight of the stiffening girders constitutes the most important single element in the suspended weight of the bridge, being for the maximum span about one-half the entire permanent load. It should be made no greater than is absolutely necessary, for the structure ought not to be kept under a continuous stress to provide a larger margin for stresses which may never occur. The Board believes that the working stresses adopted are amply sufficient for the members of the bridge.

(To be concluded next week.)

PERSONALS.

Mr. Charles G. Chase, President of the Mason Regulator Co., died in Brookline, Mass., Nov. 8, at the age of 67.

Mr. W. N. Bannard has not been appointed Division Superintendent of the New York Central R. R., as noted last week.

Mr. Peter Daly, contractor, of Cleveland, O., died Nov. 17, at the age of 63. He was connected with the Cleveland Rolling Mill Co.

Mr. Frank A. Seabert, Division Superintendent of the Delaware, Lackawanna & Western R. R., with headquarters at Buffalo, N. Y., has resigned.

Mr. J. H. Kain, formerly Chief Engineer of the Mexican Central Ry., has accepted the position of Chief Engineer of the Interoceanic Railway of Mexico.

Mr. M. B. King, engineer of the Pacific Coast Division of the United States Geological and Topographical Survey, has tendered his resignation, and will enter the service of the Japanese Government.

Mr. Carleton B. Hutchins, President of the Hutchins Refrigerator Car Co., of Chicago, and C. B. Hutchins & Son, manufacturers of freight car roofing, died at Detroit, Mich., Nov. 22, at the age of 80. He was born in Bath, N. H.

Mr. Eckley B. Coxe, M. Am. Soc. C. E., of Drifton, Pa., has resigned the offices of President of the Delaware, Susquehanna & Schuylkill R. R., the Coxe Bros. Iron Foundry & Mfg. Co. and the Cross Creek Coal Co. He is succeeded by Mr. Alfred Walters, General Manager of the New York, Lake Erie & Western R. R.

Mr. P. Elbert Nostrand, Assoc. M. Am. Soc. C. E., formerly Chief Engineer for the contracting firm of J. D. & T. E. Crimmins for 3½ years, is now in general practice as city surveyor and civil engineer, with offices at 43 East 59th St., New York city.

Mr. George Van Keuren has been appointed Superintendent of Transportation of the New York, Lake Erie & Western R. R., vice Mr. C. R. Fitch, present General Superintendent. Mr. J. S. Smith succeeds Mr. Van Keuren as Superintendent of the Jefferson Division.

Mr. John M. Evans, the new General Manager of the Sharon Iron Co., of Sharon, Pa., has been connected with the Illinois Steel Co., of Chicago, for the past two years, in charge of the structural department, and was formerly connected with the Youngstown Rolling Mill Co., of Youngstown, O.

Mr. E. H. Porter, formerly of the engineering department of the Seaboard Air Line Ry., and Mr. B. T. Elmore, late of the engineer corps of the Chesapeake & Ohio Ry., have opened an office for the transaction of general engineering and surveying work, at 15 Cotton Exchange, Memphis, Tenn., under the firm name of Porter & Elmore.

Mr. Joseph Lewis, inventor of the Lewis valve gear for locomotives, described in our issue of April 19, died at Kansas City, Mo., Nov. 19. He was a junior member of the firm of Lewis & Sons, of Manchester, in whose shops were built George Stephenson's locomotive "Rocket" and the machinery for John Ericsson's warship "Monitor." Mr. Lewis came to this country in 1868.

Mr. William T. Walters, a well-known railway and business man of Baltimore, Md., died Nov. 22, at the age of 74. He was educated in Philadelphia as a civil and mining engineer, and was engaged on several railways and located some of the anthracite coal mines in Pennsylvania. Before he was 25 he gave up engineering and went to Baltimore, where he went into the commission business. For 50 years he had been collecting art works, and had the rarest and most valuable private collection in the United States.

Mr. William F. Shunk, the well-known civil engineer, and Prof. J. D. Rothrock, a botanist of Philadelphia and West Chester, Pa., were appointed, last April, by Governor Pattison, of Pennsylvania, a Forestry Commission for that state. They are now actively at work and will report on or before March 15, 1895. From a preliminary report of progress we learn that their final report will consider the preservation and perpetuation of the trees of the state; the reclamation of waste land; the future timber supply and the relation of timbered lands to the water supply. A better road system is also among the things to be considered in connection with this subject.

Hon. George M. Rice, formerly President of the Worcester Steel Works, died at Worcester, Mass., Nov. 8. He was born in West Brookfield, Mass., in 1808. In 1846 with others he organized a company at Worcester for the manufacture of paper, calico printing and bleaching machinery, and was connected with it until 1881, when he became interested in the Washburn Iron Co., the principal interest in which passed into his hands in 1883, when he became president of the company. He took upon himself the task of remodeling the works, with the object of manufacturing steel rails, ingots and iron car wheels under the corporate name of the Worcester Steel Works. In 1883-84 a Bessemer steel works was added to the plant, and later on open-hearth furnaces were put in, and in 1888 two trains of rolls were added for the manufacture of merchant steel.

WEATHER TABLE FOR OCTOBER, 1894. (Furnished to Engineering News by the Department of Agriculture.

	Stations.	Temperature. (Deg. Fahr.) Average.	Max.	Min.	Range.	Wind. Velocity in miles per hour. Average.	Max.	Direction at time of max. velocity.	Precipitation—rain or melted snow—inches. Total.	Heaviest in 24 hours.	No. of rainy days.
Northern Cities.	Northfield, Vt.	47.8	71	30	41	8.6	36	NW	3.50	.92	15
	Portland, Me.	50.6	67	33	34	7.6	41	E	4.65	1.34	12
	New York, N. Y.	57.2	75	39	36	11.6	48	NE	5.83	1.71	9
	Pittsburg, Pa.	56.4	82	34	48	6.0	30	NW	1.72	.62	10
	Chicago, Ill	52.1	76	32	44	16.5	48	SW	.84	.34	11
	Omaha, Neb.	55.0	84	31	53	8.5	32	W	2.94	1.61	7
	St. Paul, Minn.	49.0	77	32	45	8.6	28	W	4.49	1.72	15
	Duluth, Minn	46.9	72	34	38	7.3	27	NW	4.99	1.53	14
	Bismarck, N. Dak	45.1	77	21	56	10.8	40	NW	.87	.29	6
	Average	51.1	76	32	44	9.5	37		3.31	1.12	11
Southern Cities	Washington, D. C.	57.9	84	36	48	6.6	30	NW	3.14	1.78	10
	Louisville, Ky.	59.4	87	34	53	7.5	35	W	1.20	.43	7
	St. Louis, Mo	59.6	84	38	46	11.8	37	SW	1.56	.62	10
	Savannah, Ga	68.4	89	47	42	8.7	40	S	3.17	2.37	7
	Kansas City, Mo	59.4	89	31	58	8.5	36	SE	1.49	.65	11
	Jacksonville, Fla.	71.5	90	52	38	8.1	62	SE	5.4	2.63	6
	Chattanooga, Tenn.	61.7	85	38	47	6.1	33	NW	2.18	1.72	7
	New Orleans, La.	70.8	88	47	41	8.0	48	NW	.89	.89	1
	Memphis, Tenn.	64.2	87	39	48	6.5	36	SW	.55	.38	3
	Palestine, Tex.	69.8	89	39	50	5.4	26	NW	1.04	.72	4
	Average	64.3	87	40	47	7.7	38		1.85	1.22	7
Western Cities.	Helena, Mont.	46.8	74	16	58	8.6	40	W	.68	.27	4
	Port Angeles, Wash	46.8	63	33	30	4.7	30	W	2.75	.74	24
	San Francisco, Cal	59.6	89	49	40	9.0	32	SW	1.73	.64	5
	Salt Lake City, Utah	53.2	77	28	49	5.9	30	SE	1.01	.45	6
	Santa Fe, N. Mex	51.9	73	21	52	6.5	36	SE	1.05	.52	6
	Denver, Colo.	54.0	80	21	59	7.8	36	NW	.19	.19	1
	Yuma, Ariz.	74.6	101	47	54	4.9	34	N	.84	.84	1
	Average	55.3	80	31	49	6.8	34		1.18	.52	5

NEW PUBLICATIONS.

THE PRACTICAL DESIGNING OF STRUCTURAL IRON WORK. By Henry Adams, M. Inst. C. E., M. Inst. M. E., F. S. I., etc., Professor of Engineering at the City of London College. London: E. & F. N. Spon, and New York, Spon & Chamberlain. 8vo; cloth; pp. 194; 180 illustrations; $3.50.

We suppose this book must be of some use to English engineers or it would not have been published. To an engineer in this country, however, the book appears to be chiefly useful as a curiosity. Chapter I., of 16 pages, is devoted to the detailed design of a small cast iron girder of 10-ft. span, to carry a distributed load of 10 tons. Why any engineer should ever want to design such a thing in these days, when rolled beams are selling for 1½ cts. per lb., is a question on which the author throws no light. No fewer than three other chapters are devoted to cast iron construction, however, or practically about one-fourth the book. In the chapter on cast iron bridge girders, the author refers to the fact that for ten years past the construction of cast iron railway bridges has been prohibited; but he goes ahead with his discussion just the same. It is queer that our British cousins should stick so obstinately to cast iron for bridges and girders, and yet refuse, on the score of danger, to use it for car wheels. The plan of the book in general is to take in each chapter some typical case and work out its solution, the student being expected to absorb enough knowledge of general principles in the process to undertake similar calculations. It is needless to say that text-books of this type were long ago discarded in American technical schools.

INDIA AS A FIELD FOR INDUSTRIAL ENTERPRISE. Published by "The Indian Engineer," Calcutta, India, and London, England. Paper; 4to; pp. 26; price, 1s. (25 cts.).

This pamphlet is a reprint from "The Indian Engineer's Diary and Reference Book for 1895," and on the first page it is stated that the men who will do good to India are not those of extraordinary proficiency in Indian tongues and who are intimate with educated natives, but rather the men who are full of English energy and enterprise, free from official trammels and who are ready to make a dash at any opening that may offer. As in many parts the natives are prejudiced against railways, it is pointed out that traffic may be facilitated by laying narrow-gage tracks alongside the highways upon which cars may be hauled by cattle walking on the roadway. There are numerous interesting statistics of population, industries, manufactures, products, imports and exports, public works, etc. In 1893 the output of coal amounted to 2,529,855 tons and in 1893 the petroleum product amounted to 8,725,000 gallons, while 67,000,000 gallons were imported in 1893 (26,000,000 from the United States and 38,000,000 from Russia). The facts and figures given in the book show that there is an enormous and increasing field in India for British capital and enterprise, and it may be added that the field is also open to some extent for American capital and enterprise, but the field of operation must be carefully chosen and the enterprise must be managed with discretion.

THE LIFE AND INVENTIONS OF THOMAS ALVA EDISON. By W. K. L. Dickson and Antonia Dickson. With drawings and photographs by W. K. L. Dickson, R. F. Outcalt, L. Bauhau and J. Rickilton. Chatto & Windus, London. Octavo; 362 pp., and many illustrations.

This is a very handsomely printed, illustrated and bound work. The detail of the life of Mr. Edison is always interesting as picturing the early struggles, methods and experiences and final success of one of the very remarkable men of this century. The record of his many inventions is well told and illustrated, and while there is considerable "padding" in the shape of material not at all connected with the discoveries that have made him famous, it is all very readable and enables us to form some estimate of the man, as well as of the inventor. If there is anything in the doctrine of hereditary longevity the useful labors of Mr. Edison may be extended through another half century or so, for his father is living, hale and hearty, at the age of 90 years, and his grandfather and great-grandfather lived to be over 102 and 103 years of age, respectively, according to this biographer.

REPORT OF THE CHIEF OF THE DIVISION OF FORESTRY FOR 1893.—By B. E. Fernow, Chief of Division, Department of Agriculture, Washington. D. C. Pub. doc.; paper; 8vo; pp. 60.

This report will abstracted at length in another issue.

SOCIETY PROCEEDINGS.

ENGINEERS' CLUB OF ST. LOUIS.—At the meeting on Nov. 21 Prof. C. M. Woodward read an address on "The Relation of Technical to Liberal Education." Prof. H. A. Wheeler reported the results of a recent visit to Cincinnati, where he had gone to examine the Simonin desiccation process for the reduction of garbage. He explained the system in detail and compared it with the Merz system, from which it differed principally in that the desiccation and oil extraction were carried on in the same tank, instead of in separate vessels. He considered the process inferior to the Merz, both in its practical operation as shown in Cincinnati and in the principles underlying its use.

W. H. Bryan, Secy.

AMERICAN SOCIETY OF CIVIL ENGINEERS.—At the meeting on Nov. 21 Mr. Cope Whitehouse delivered an illustrated lecture on the project of turning the flood waters of the Nile into the Rafyan basin (the site of the ancient lake Moeris), to form a storage reservoir for irrigation during the dry season. This project was described in full in our issue of Nov. 9, 1889. Several plans have been proposed by English engineers for open dams in the river itself, similar to the great Nile barrage near Cairo, and in the discussion Mr. Tratman referred to the suggestion made at various times for utilizing Lakes Albert and Victoria as storage reservoirs by constructing dams across the outlets, and instanced Gen. Fischer's plan for a dam with shutters at these outlets, giving a sufficient supply of water for a canal from the Nile at Berber to Suakin.

ENGINEERS' CLUB OF PHILADELPHIA.—Meeting of Nov. 17. President John C. Trautwine, Jr., in the chair, and 73 members and visitors present. The subject of membership in the Association of Engineering Societies was taken up, and after considerable discussion it was voted that, after careful consideration, it was not deemed advisable to relinquish the publication of its own proceedings by joining the Association. Mr. George R. Bullock made some informal remarks on "Highway Improvements in Philadelphia." The rounding of street corners was being gradually carried forward among other improvements; but to improve the small streets still paved with cobble and rubble would cost from $15,000,000 to $17,000,000. The street lighting system, he said, was probably the best in the world, and the building laws were much improved on old conditions. The most serious trouble in maintaining highways there was due to the want of legislation assigning to some distinct authority the duty of enforcing laws already in existence. Mr. John L. Gill, Jr., exhibited and explained a series of photographs projected from the stereopticon, which were taken in the neighborhood of Shamokin after the recent explosion of 27 out of a nest of 36 boilers. These showed that the fracture of the boiler shell in all cases was circumferential and near the rivet seam, and that the force of the explosion must have been terrific, as some of the boilers were imbedded for over 30 ft. in the side of a culm bank some distance from the site of the explosion.

L. F. Rondinella, Secy.

BOSTON SOCIETY OF CIVIL ENGINEERS.—A regular meeting of the society was held on the evening of Nov. 21, the meeting being prefaced by a supper at the Quincy House. The headquarters of the society are now at 36 Bromfield St., where a reading room and library are maintained. The meeting was held in a hall in the same building. During the meeting the subject of rooms for the coming year was discussed and finally referred to the Board of Government and Committee on Headquarters. The possibility of co-operating with the New England Water-Works Association in the matter of rooms was mentioned.

The feature of the meeting was the reading and discussion of a paper by Mr. Allen Hazen, of the Massachusetts State Board of Health, on "European Water Supplies." Mr. Hazen recently returned from Europe, where he visited many of the water-supply works of the large cities and examined them in detail.

Mr. Hazen first spoke of the low per capita water consumption in Europe, which, as is well known, is far below that of American cities, a very common range being from 20 to 50 or sometimes 60 gallons. The latter figure is considered almost as extravagant in Europe as 150 to 200 gallons is here.

Fire protection abroad, in many cities at least, is on a far different basis than in America, fireproof buildings being compulsory. In Berlin the total water consumption for fire protection in a whole year was not over 100,000 gallons. This low fire consumption, coupled with the small amounts used for other purposes, makes small mains possible, and in this way perhaps lessens the leakage. Meters are extensively used in German cities.

Two years ago Hamburg was the only German city using unfiltered surface water, and the cholera epidemic of 1892 caused the construction of a large filtration plant for the supply of that city. At present, of 30 large German cities, 19 use ground water, and the balance filtered surface water. The use of unfiltered surface water in Germany is now prohibited by the government, and certain regulations are in force defining the manner in which filtration shall be conducted.

At Hamburg the special laboratory for the examination of the city water is housed in a two-story brick building, and was the finest laboratory of the kind seen by Mr. Hazen while abroad. Here 30 separate bacterial examinations are made every day, including Sundays, or nearly 11,000 a year.

At Dresden Mr. Hazen saw an interesting infiltration gallery from which the city water supply is drawn. The engineer of these works believes that this gallery, which is near the river, receives water entirely from the land side. Another gallery is to be built on the other side of the river, and at some distance.

The newer underground supplies in Germany are being developed by means of tube wells. In testing such wells after construction at Leipsic, a trolley has been used for moving the pump from one well to another. The water here contains iron, which is removed by rapid filtration. The entire daily capacity of the wells is 16,000,000 gallons.

At Charlottenburg, also, the water contains iron, which is removed by passing it through coke and then filtering it through sand and gravel at the rate of 25,000,000 gallons per acre per day.

One of the engineers whom Mr. Hazen met prospects for underground supplies in an interesting manner. He puts down three wells, located at the three points of an equilateral triangle, and from the relative heights of water in the wells deduces the direction of the underground flow. The velocity of the flow is tested by putting salt in one of the wells and testing the times and amounts of increase in chlorine at the well lower down. This engineer had no confidence in pumping tests to determine the permanent yield of wells.

At Munich 7,800 ft. of gallery are used to develop water from springs, but a part of the galleries does little collecting, serving mostly as a conduit. The average daily consumption is 11,000,000 gallons.

The water supply of Vienna, or a large part of it, comes from springs in the mountains 60 miles away. In July, 1894, a daily supply of 21,000,000 gallons was being drawn from springs within a radius of ¼ mile. The minimum yield of these springs is in the winter, owing to snow in the mountains. Mr. Hazen stated that he never knew what a spring might be until he saw the monsters here and elsewhere in Europe. From the springs the water is conveyed to Vienna through an aqueduct which has a fall of 11,000 ft. in the first 10 miles, and of 10 ft. per mile over the balance of the distance, which latter is mostly in tunnel. On the upper section gates are used to throttle the head for every 100 ft. of fall.

Paris also has a spring-water supply, no other water now being admitted to the houses. A new supply introduced in 1892 comes to the city through a 30,000,000-gallon aqueduct 63 miles long. A minimum daily amount of 53,000,000 gallons of spring water is used. The streets are washed (not sprinkled) with river water. One reason why the Paris sewers have the reputation of being so clean, Mr. Hazen says, is that but little house sewage enters them.

The suburbs of Paris are supplied by a company, which is to filter the supply, supplementing filtration by previous treatment, in an Anderson revolving purifier (treatment with iron punchings, see Eng. News, Feb. 14, June 6 and Sept. 5, 1885; Jan. 1, 1887; April 25, 1891, under Society Proceedings, and Sept. 22, 1892).

Amsterdan, Leyden and The Hague develop a supply from the sand dunes by means of canals. The Dutch cities filter their water on principle, whether necessary or not, but the Amsterdan supply has to be filtered on account of an algae growth which takes place in the canals. Covering the canals has been spoken of, but is not considered desirable.

On the Continent impounding reservoirs are almost unknown, but they are common in England, the Vyrnwy reservoir for the Liverpool supply being a notable example. Water from these reservoirs is generally filtered in England, and must be so treated in Germany. The Manchester supply is not filtered, and, of course, the Glasgow supply, from the beautifully clear and pure Loch Katrine, is not filtered.

The discussion on the paper was opened by Prof. T. M. Drown, who referred to a visit made by him this summer to the Vyrnwy reservoir, showed a number of fine views of the reservoir, and gave some statistics regarding the work. No stripping of soil from the reservoir site was done, but a few trees were taken out for timber. Since the first year there has been no trouble from foul water in the reservoir. The water is filtered through beds with an area of 216,000 sq. ft., or a little over five acres.

Prof. Sedgwick referred to the thorough way in which municipal work is done abroad, and asked why we do not do as well here. The reason is, he thinks, that while we have plenty of good engineers, we have poor city government. We need a class of governors or administrators holding office for life or good behavior. Mr. Hazen's paper should teach us lessons, not as engineers, but as citizens, so we can take rank with the other nations of the earth in the matter of civic administration.

Mr. Desmond Fitz Gerald, M. Am. Soc. C. E., said that a revolution is now going on in the matter of the quality of water supplies all over the world. There is more need of stripping the storage reservoirs of New York or Boston than of those abroad, since the water here is not filtered. The separation of water supplies into potable and general, making a double system, is an interesting question for study.

In reply to questions from Mr. Fitz Gerald, Mr. Hazen stated that the recognized maximum rate of filtration in Germany is 2,570,000 gallons an acre. The cost of filtration of course varies locally, perhaps averaging 1 ct. per 1,000 gallons in Germany, 4% being allowed for interest on the investment, 2% for sinking fund, and 10% for the depreciation of the more perishable portions of the plant.

COMING TECHNICAL MEETINGS.

FRANKLIN INSTITUTE, PHILADELPHIA.
Nov. 30. "Application of Electricity to Bleaching," Mr. L. J. Matos. Secy., W. H. Wahl.
ENGINEERS' CLUB OF PHILADELPHIA.
Dec. 1. Secy., L. F. Rondinella, 1122 Girard St.
AMERICAN SOCIETY OF MECHANICAL ENGINEERS.
Dec. 3 to 7. Secy., F. R. Hutton, 12 W. 31st St., New York.
CIVIL ENGINEERS' SOCIETY OF ST. PAUL.
Dec. 3. Secy., C. L. Annan, City Engineer's Office.
WESTERN SOCIETY OF ENGINEERS.
Dec. 5. Secy., Thomas Appleton, Lakeside Bldg., Chicago.
ENGINEERS' CLUB OF ST. LOUIS.
Dec. 5. Annual meeting. Secy., W. H. Bryan, Turner Block.
AMERICAN SOCIETY OF CIVIL ENGINEERS.
Dec. 5. Secy., Francis Collingwood, 127 E. 23d St., N. Y.
CANADIAN SOCIETY OF CIVIL ENGINEERS.
Dec. 6. Secy., C. H. McLeod, 112 Manefield St., Montreal.
TECHNICAL SOCIETY OF THE PACIFIC COAST.
Dec. 7. Secy., O. Von Geldern, 719 Market St., San Francisco.
MONTANA SOCIETY OF CIVIL ENGINEERS.
Dec. 8. Secy., G. O. Foss, Helena, Mont.
ENGINEERS' CLUB OF INDIANAPOLIS.
Dec. 8. Secy., C. C. Brown.
WISCONSIN POLYTECHNIC SOCIETY.
Dec. 10. Secy., Geo. G. Mason, 144 8th St., Milwaukee.
ENGINEERS' CLUB OF KANSAS CITY.
Dec. 10. Secy., F. W. Tuttle, Baird Building.
CIVIL ENGINEERS CLUB OF CLEVELAND.
Dec. 11. Secy., F. C. Osborn, 721 Hickox Building.
NORTHWESTERN SOCIETY OF ENGINEERS.
Dec. 11. Secy., D. W. McNorris, Burke Building, Seattle, Wash.
NORTHWESTERN RAILWAY CLUB.
Dec. 11. Secy., W. D. Crosman, Ryan Hotel, St. Paul.
DENVER SOCIETY OF CIVIL ENGINEERS.
Dec. 11. Secy., F. Ed. King, 36 Jacobson Block.
NEW ENGLAND RAILROAD CLUB.
Dec. 12. Secy., F. M. Curtis, P. O. Box, 1576, Boston, Mass.
ENGINEERING ASSOCIATION OF THE SOUTH.
Dec. 13. Secy., Hunter McDonald, Nashville, Tenn.
ENGINEERS & ARCHITECTS' CLUB OF LOUISVILLE.
Dec. 13. Secy., G. W. Shaw, Norton Building.
NORTHWESTERN TRACK AND BRIDGE ASSOCIATION.
Dec. 14. Secy., D. W. Meeker, St. Paul, Minn.
ENGINEERS' CLUB OF MINNEAPOLIS.
Dec. 17. Secy., E. Nexsen, Kasota Block.
WESTERN RAILWAY CLUB.
Dec. 18. Secy., W. D. Crosman, Rookery Building.
COLUMBIAN ENGINEERING SOCIETY.
Dec. 18. Secy., W. F. Hart, Washington, D. C.
ASSOCIATION OF ENGINEERS OF VIRGINIA.
Dec. 19. Secy., J. H. Pilcher, Roanoke, Va.
BOSTON SOCIETY OF CIVIL ENGINEERS.
Dec. 19. Secy., S. E. Tinkham, 36 Bromfield St.
NEW YORK RAILROAD CLUB.
Dec. 20. Secy., John A. Hill, Temple Court, N. Y. City.
ENGINEERS' SOCIETY OF WESTERN PENNSYLVANIA.
Dec. 20. Secy., D. Carhart, Carnegie Library Building, Allegheny.
ENGINEERS' CLUB OF CINCINNATI.
Dec. 20. Secy., J. F. Wilson, 24 W. 4th St.
SOUTHERN AND SOUTHWESTERN RAILWAY CLUB.
Dec. 26. Atlanta, Ga., Secy., F. A. Charpiot, Macon, Ga.
CENTRAL RAILWAY CLUB.
Jan. 13. Secy., S. W. Spear, East Buffalo Iron Works, Buffalo, N. Y.

ENGINEERING NEWS
AND
AMERICAN RAILWAY JOURNAL.

Published Weekly at Tribune Building, New York.
Entered at the Post Office, New York, as Second Class Matter.

VOL. XXXII. THURSDAY, NOV. 29, 1894.

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KEGAN PAUL, TRENCH, TRUEBNER & Co. (Limited), Paternoster House, Charing Cross Road, London, Eng.
SAMPSON LOW, MARSTON & Co. (Limited), St. Dunstan's House Fetter Lane, London, Eng.

SUBSCRIPTION RATES: United States, Canada and Mexico, One Year, $5.00: 6 months, $2.50: 2 months, $1.00: single copies, 15 cents. To all other countries in the Posta Union, add $2.08 per annum (4 cents per number) to above prices for postage. No club rates allowed. Mailing addresses may be changed at will by sending both old and new address. We shall be obliged if subscribers who fail to receive their papers promptly will notify us without delay.

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The bridge which the Long Island R. R. Co. is about to build across the East River at Blackwell's Island will surpass every cantilever structure in the world except the Forth Bridge in length of span, its two channel spans being each 846 ft. in length, or 56 ft. longer than the channel span of the Memphis bridge. Of course, such a span is trivial beside the 1,700-ft. spans of the Forth Bridge, but the structure itself will rival in some particulars even that great work. It will have four tracks and two driveways, against the two tracks of the Forth Bridge, and it will weigh, according to published announcements, a little over 11 tons per lineal foot, against 10 tons 1,381 lbs. for the Forth Bridge.

Applications are coming to this office from engineers seeking employment on the Panama Canal, upon which, it is alleged, work has been renewed. We have already said what we think of this new enterprise, and, to repeat its substance, will simply remark that we regard the renewal of activity there as a passing bubble which will soon be pricked. The present promoters have very little money, comparatively speaking, and the outlook for obtaining more from Frenchmen, once so badly defrauded, is very poor indeed, if the Paris press is any guide. Now, word comes from Panama that crowds of American mechanics are literally dying there from exposure and neglect, with no work to do, and every steamer increases the number. These men went there under fraudulent contracts, made by irresponsible parties, who promise remunerative employment on the canal. The only labor now employed on the canal is made up of Jamaica negroes, who are paid 60 to 70 cts. per day in Colombian money, or 27 to 31 cts. per day in American money, and a chance to compete with this labor is all that the canal managers have to offer to those seeking work. A word to the wise should be sufficient. The Panama Canal is a very good place for American engineers, mechanics and laborers to stay away from.

In our issue of Jan. 19, 1893 we gave a brief abstract of the decision of Judge Taft, of the U. S. Circuit Court, upholding the validity of the Hall patent on a process for producing aluminum in the suit of the Pittsburg Reduction Co. vs. the Cowles Electric Smelting Co. The Nov. 6 issue of the "Official Gazette" of the U. S. Patent Office contains the full text of Judge Taft's decision, and we advise any of our readers interested in the history of aluminum production processes to secure a copy. The defendants in the suit ransacked the history of all that prior inventors and chemists of all nationalities had done, in the endeavor to show that Hall's process was not novel. The court in its decision takes up, one by one, these various processes alleged to anticipate the Hall process, and shows clearly just the reasons why the alleged anticipation was not an anticipation within the meaning of the law.

From its general bearing as a precedent in patent law practice the decision is also of the greatest interest, and, with the recent decision by Judge Shipman in the Westinghouse brake case, it plainly lays down a very important principle of the patent law with which every engineer should be acquainted. This principle is that the inventor who, by the work he has done, is actually a "pioneer" inventor, will not be limited in his rights to a broad patent by the prior patents of other inventors who have been working on similar lines, but without fully discovering or disclosing the important process which the pioneer inventor finally brings to light.

It is most fortunate that the courts have laid down so plainly this principle, for otherwise the work of the real pioneers in the field of invention could seldom obtain the protection it deserves. The past half century of invention has produced nearly, or quite, a million patents in all the countries of the civilized world, extending to every branch of industrial activity. In addition to this we have an appalling mass of technical literature, books and periodicals, in all languages. The inventor who nowadays makes a really new and important advance is well nigh certain when he files the record of his work with the patent office to find that from one to a dozen prior inventors have been groping in the same direction, and have used some of the important instrumentalities necessary to his process without perceiving or disclosing their real significance. But, according to the recent decisions of Judges Shipman and Taft above referred to, and we might cite also the decision in the Edison incandescent lamp case, the real "pioneer" inventor is still entitled to the protection of the courts, and his patent will receive the broadest construction which its terms permit. This interpretation of the patent law is in accordance with the spirit of the law and also with sound public policy and good sense. Indeed, we may go even farther and say that the need is already felt of some radical reforms of the law, which shall go still farther in this direction and which shall, among other things, enable an inventor to obtain protection regardless of anticipation by expired and unused patents, which, while nominally made public, are actually about as far from being within the knowledge of the public as if they were buried in the sea.

The work of the Lawrence, Mass., experiment station on the purification of sewage by filtration has now a world-wide fame; and the results which have been obtained there are serving as a valuable guide to engineers in the construction of important plants. The work which the station has done, coupled with the experience gained at Marlboro, Framingham, and a number of other towns now discharging their sewage on disposal beds, proves that sewage treatment by sand filtration is no longer an experiment. We print on another page a review of the latest tests made at the Lawrence station, the interest of which is hardly surpassed by any work which has been done there. As every engineer knows, the great obstacle to the adoption of land disposal for the sewage of any city of considerable size is the amount of land required. The Lawrence experiments have shown that, speaking generally and using round numbers for convenient memorizing, an acre of land may be made to dispose of the sewage of a town of 1,000 population, allowing 100 gallons per capita daily as the rate of flow.

At this rate land disposal of sewage is practicable for almost any small town and for a great many cities of moderate size; but when we consider land disposal for the sewage of a city of 50,000 inhabitants or more, and make due allowance for the surplus area required for handling the maximum flow at all times, the amount of land required becomes a big obstacle to the adoption of this plan of sewage purification on account of the high cost of land near large cities and the difficulty of securing proper location and filtering material.

Now, the able experimenters at Lawrence have been at work of late testing different methods which have been proposed for making a given area of land purify a much larger quantity of sewage, and the results obtained, which are reported in another column, are very encouraging. Briefly stated, they find that by running the sewage through 5 ft. of gravel the size of buckshot, through which a current of air is passing, and then turning the sewage upon the sand filter, a combined rate of filtration, for the gravel and sand, of 320,000 gallons per acre per day was secured, and this with a very perfect purification, 95.5% of the organic matter and 99.8% of the bacteria being removed. It is notable that fully three-fourths of the organic matter was removed in the gravel tank.

The importance of these results cannot be overestimated. If by these simple methods a sewage filter may be made to purify over three times as much on a given area as has heretofore been considered possible, the way is open for the disposal of the sewage of many of our large inland cities in a manner more in accord with modern sanitary science than the present universally adopted plan of discharge into the lakes and rivers.

We have before referred to the importance of separating house sewage and storm water if sewage treatment, either by filtration or by chemicals, is to be made a success. If sand filters can be made to pass sewage at much higher rates that heretofore employed, such separating is not so great a necessity in the case of small towns. On the other hand, it becomes of much more importance in the case of cities of considerable size; for land disposal would be at once feasible with many of them if the house sewage alone was considered, while it is out of the question to attempt to handle the storm water in this way. In view of these facts, the engineer who looks to the future will do well to use his influence for the separation of storm and sanitary sewers in every city where future land disposal is even remotely possible.

SHALL FREIGHT BE HANDLED ON THE NEW YORK RAPID TRANSIT RAILWAY?

Mr. John H. Starin, of the Rapid Transit Commission, who is now in Europe, has expressed in an open letter to his associates some general views upon the problem which they are now discussing. Mr. Starin advocates an underground system, with the four tracks on a level, but the important and surprising feature of his letter is his proposition that the commission shall attempt to provide for the transport of freight as well as of passengers. His chief argument for this action is that goods are brought to the city limits by the most expeditious and economical methods that the outlay of capitalists can command and the schemes of men can devise, and are then taken to their final destination by the slow and expensive system of trucking. He would make the proposed rapid transit line "a great railway," fitted to carry all the internal commerce of New York. He thinks the rapid transit road should make it possible for a passenger from a distant inland city to be landed without change of cars in lower New York city, and a carload of freight would be delivered likewise at the underground station nearest to its city destination.

While the law that clothes the Rapid Transit Commission with its great power permits that body to provide for the handling of "passengers and property," there can be little doubt that the "property" referred to is such mail and express matter as may reasonably be carried on a city passenger railway without obstruction to the regular movement of trains. So far as we can find, the proposition to lay upon the Rapid Transit Commission the burden of devising a system of local freight distribution in the metropolis has never been contemplated, either by the framers of the law, the legislature which passed it or the voters who set the seal of their approval on it at the general election.

But whether or not the commission has legal authority to attack the freight distribution problem is a question of less serious import than Commissioner Starin's proposition to run freight cars on the tracks of the rapid transit road. To appreciate the gravity of this proposal, it is necessary to see just

what the projected New York rapid transit railway really is to be, according to the general plans heretofore made public and approved. We may best define it as a system for transporting passengers from one point to another in not only less time, but far less time than has ever before been tried or attempted in any city in the world. It is not often realized how slow are our best existing systems of interurban transportation compared with ordinary railway speeds. To go from the Battery to 155th St. on an ordinary train of the Manhattan Elevated Ry. requires 52 minutes. The distance is 10¾ miles. Thus the average speed, including stops, is but little more than 12 miles per hour. In the same time, 52 minutes, a passenger on the Empire State express will have traveled a distance of about 47 miles, or nearly four times as far. Thus, if the same speed were possible on the city road as on the trunk line, a passenger should be conveyed from the Battery to 155th St. in about 12 minutes.

Now, the New York rapid transit railway is designed to reduce this broad gap between speeds of city transit and speeds of railway express trains, and the mechanism by which it is proposed to do it is so simple that any one can understand it. As most of our readers doubtless know, the rapid transit road is to have four tracks, of which two will be for local trains and two for express trains. The local trains will stop at stations short distances apart. The express trains will only stop at intervals of two or three miles, and the stations will be located at the points where traffic is most concentrated. Thus the local trains will serve the important function of collecting and distributing passengers from the express stations in addition to the handling of passengers who wish to go short distances only.

But a second element, quite as important in time-saving as the co-operation of the local and express service, is a short interval between trains. This interval should be made as short as possible, with the maintenance of sufficient headway to insure safety, and then it should be rigidly adhered to through the whole 24 hours of the day, except perhaps the time between midnight and 5 a. m. Unless we can have this short headway maintained, the time lost in waiting for trains will seriously impair the efficiency of the service. If a man has to wait five minutes for a local train, another five minutes for an express train, and still another five minutes for a local train again after his ride on the express train, he will be apt to feel considerable disgust with that kind of rapid transit. Now, a great advantage of the operation of the road by electricity is that the capacity of the road can be suited to the traffic by varying the length of the train, and the interval can be kept constant. With steam locomotives it costs nearly as much to run a short train as a long one. With electrical operation the cost per car mile should not be greatly different whether a car is run separately or in a train. Everyone knows that frequency of trains is a most important element in attracting traffic even on an ordinary city railway; but on this road, with its transfers from local to express trains and vice versa, a very short interval will be of far greater importance.

The bearing of this on Commissioner Starin's proposition is evident. The tracks of the road are to be fully occupied from early morning till midnight by passenger traffic; they must be so occupied to give the best and quickest service. There is, therefore, no room for the running of freight trains over the tracks in the daytime, and even in the four or five hours after midnight, if the road is operated with proper regard for the convenience of the public, cars will be run at reasonably frequent intervals on both the local and express tracks. It may not be realized, by the way, how little rolling stock it is necessary to keep moving to give a frequent train service on high-speed tracks. Suppose, for example, the length of the road is 15 miles and the trains on the express tracks make 30 miles per hour, including stops. Then only six trains will need to be kept running on the express tracks to maintain a ten-minute service over the whole circuit.

It need hardly be said that this consideration, the fact that the tracks of the proposed road will have no room for any other than the traffic they are designed to carry, is quite sufficient to condemn the proposal to run freight cars over them. But this is far from being the sole reason. If narrow Broadway, lined with lofty and costly buildings, is to be the downtown route, as Mr. Starin proposes, it is very essential for economy and safety of construction that the cross-section of the tunnel be as small as possible. Safety in operation also demands that the tracks be absolutely unobstructed from one end of the system to the other, and this is especially necessary in a tunnel.

Mr. Starin would change all this. His tunnel would have to be roomy enough to accommodate the largest Pullman car and the largest freight car, with all the extra cost involved in this increase of tunnel dimensions. Supplementary or side tunnels and tracks would have to be provided for handling heavy passenger cars and storing freight cars during the loading and unloading process. This means turnouts and switches, the cutting of the main line tracks and the addition of many and permanent menaces to human life. Then, upon what system is he going to handle his freight? He speaks of devoting part of the night to this service, when the express tracks are supposed to be idle. But if he connects with the inner two express tracks, the four tracks being supposed to be on a level, he must cross over the outer tracks and add dangerous grade crossings to the dangerous switches on the inner track. If he uses the local outer tracks at night, he has still the element of danger at every switch and defeats one of the chief advantages of electric power, the ability to move frequent one-car trains at about the same cost required to move a heavier train at longer intervals. While the night traffic is small in numbers, comparatively, the people are just as anxious to reach their homes as in the daytime, more so, in fact, and a properly operated electric road would supply the rapid transport demanded.

By any system of operation which an engineer could devise, within reasonable limits of cost, the operation of such a combined passenger and freight tunnel would be one inevitably accompanied by provoking blockades and delays to the passenger traffic, and would have in it ever-present elements of great danger to life. The problem is complicated enough now without adding to it the features proposed. The space contiguous to the underground route on Broadway is now very limited and is fully occupied for commercial purposes, and the owners would seriously object to having any further tunnelling in their immediate neighborhood. Another operating element to be considered is the fact that to get out of the city again every freight car would have to pass down to the Battery to get upon the uptown track, unless cross-overs were made at intervals, a plan that no engineer of experience would ever dare to propose.

And, finally, when we inquire concerning the necessity for an underground freight line we fail to see any special advantage in it. The North and East rivers are natural distributors of freight coming from distant points; they are now well utilized for this purpose, and deliver goods within a reasonable haul of any downtown destination directly from the car in which it made its journey to the city. This haul cannot be avoided by any combination of passenger and freight traffic on the underground system, for it is absurd to suppose that side tracks are to be run into every merchant's cellar. If the time does come when it is needful to distribute freight by rail in the city, an elevated belt line along the river fronts, devoted solely to this purpose will do it vastly better and more cheaply than it could be done on Broadway and without interference with the rapid transit railway, which should be strictly devoted to the safe handling of passengers with the greatest possible promptness and rapidity.

LETTERS TO THE EDITOR.

A LONG MULTIPLICATION TABLE.

Sir: In reply to inquiry of "S" in "Notes and Queries," permit me to say that Crelle's Rechentafeln is a complete multiplication table of numbers from 1 × 1 to 999 × 999, and by it also numbers of any number of figures can be multiplied three places at once, thus reducing the number of partial products and reducing the liability to error. It has parallel explanations in German and French for multiplication of numbers above 1,000. Published in Berlin; can be purchased of A. H. Smythe, Columbus, O.; price, $5. Several years' use has not disclosed any error in this work. G. E. H.

New Philadelphia, O., Nov. 24, 1894.

DIAGRAMS FOR DISCHARGE OF SEWERS.

Sir: In reference to the "Diagram for Discharge of 2-ft. to 7-ft. Brick Conduits Flowing Full," by Mr. F. S. Bailey, which appeared in your issue of Nov. 15, I desire to call your atention to the fact that practically the same diagram is among those designed by Mr. Rudolph Hering, M. Am. Soc. C. E., in 1877, a full description of which was given by him in a paper read before the American Society of Civil Engineers in October, 1878 (Trans. Am. Soc. C. E., vol. VIII., p. 1). In that paper Mr. Hering gives diagrams for pipe sewers from 6 ins. to 36 ins. in diameter, for egg-shaped sewers from 1 ft. 6 ins. × 2 ft. 3 ins. up to 6 ft. × 9 ft.,

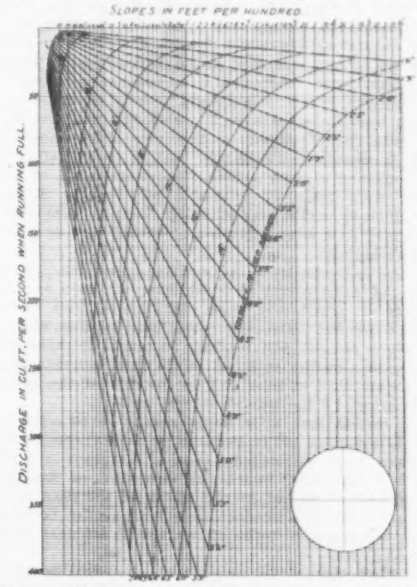


Diagram Showing Relation Between Size, Slope, Velocity and Discharge of Sewers.

Coefficient of Roughness n = 0.013 Kutter.

and for circular sewers from 3 ft. to 16 ft. in diameter; and in each case with three values of n, viz.: 0.011, 0.013 and 0.015.

These sewer diagrams are, so far as I know, the first of the kind which were ever published. In 1880 the writer assisted Mr. Hering in calculating and drawing, according to the directions given in the above paper, a series of diagrams on a large scale for various shapes, for sizes from 4 ins. to 20 ft. in diameter, and for several values of n. I enclose one of these diagrams. Yours truly, T. J. McMinn.

New York, Nov. 23, 1894.

NATURAL CEMENTS AS MATERIAL FOR CONCRETE.

Sir: In your issue of the 8th inst. I notice an article upon the tests for crushing strength of 12-in. concrete cubes, made by Mr. G. W. Rafter, M. Am. Soc. C. E., which tests appear in the Report of the State Engineer on a project to build storage dams along the Genesee River. As to these tests you say with regard to Rosendale or natural cement concretes:

> They are not equal to Portland cement concrete, however, and in the proposed work for which the tests were made, the engineer rightly says should not be considered.

Without wishing to question at all the accuracy of Mr. Rafter's method of testing the material at his command, nor its condition at the time the tests were made, it seems something of a hardship that all natural cement concrete should be adjudged "as not to be considered," because not equal to Portland in a showing that, as you justly say, "indicates that natural cement concretes are extremely unreliable, and this is certainly not true when the cements are properly tested and the construction of the concrete carefully supervised."

In a letter dated Aug. 9, 1883, Gen. Q. A. Gillmore, U. S. A., who may be quoted as an eminent authority on cement concretes, puts the case of the value of natural as against Portland cement for concrete very aptly to Gen. Chas. P. Stone, who had sought his advice in regard to the concrete foundation of the Bartholdi Statue of Liberty. Gen. Q. A. Gillmore says:

(a) Having a concrete of a given quality to make, it can be made at less cost with the best Rosendale (or natural) cement than it can be with Portland cement, even if the duty on the latter be remitted.

(b) At a given cost a better concrete can be made with Rosendale than with Portland cement.

(c) One and a half barrels of best Rosendale cement will produce as much concrete and of as good a quality as one barrel of Portland cement.

General Stone thereafter made crushing tests of one of the brands given in your article as a natural cement (Norton), tested by Mr. Rafter, and at the conclusion of the work, having adopted it in the founda

tion of the statue, published the following interesting results:

Concrete 12-in. cubes made of 2 parts cement (Norton), 2 parts sand (ordinary), 7 parts stone (trap), crushed at the end of six months under a pressure of 58.53 net tons per sq. ft.

At the end of 27 months the average in a similar set of cubes was 97.52 net tons per sq. ft.

At the end of 28 months similar cubes gave an average of 104.54 net tons per sq. ft.

These cubes were not made of concrete specially prepared for the tests, but were made from the regular batches of concrete going into the work at the time, the mould being filled from the barrows haphazard as the concrete was being dumped into place.

When it is stated that great structures, such as the Brooklyn Bridge, the Washington Bridge and many other large engineering and architectural works stand upon natural or Rosendale cement, and that for many years no cement was used in government public works, dams, aqueducts, reservoirs, river and harbor works, or fortifications, except the natural cement (Portland not having been imported here 20 years ago, and not having been manufactured in this country previous to 1876), it cannot be justly said that if, as you state in the beginning of your article, "the tests made by Mr. Rafter were made to determine whether the natural cement made within easy shipping distance were adapted to making a strong durable concrete," that they are not so adapted.

It has come to be a craze with many who are in charge of construction to insist upon the Portland cement in all foundation work. This arises from losing sight of General Gillmore's truism that 1½ bbls. of best Rosendale cement will produce as much concrete and of as good a quality as 1 bbl. of Portland cement. It is safe to say that at least 25% in the cost of the material is saved by the use of natural cement.

It is certain that little better results as to strength are obtained from either Portland or natural cement today than were obtained by General Gillmore in 1883. This is a matter of record. In view, then, of the service of natural cement in the works of the past, is it fair to dismiss this product as untrustworthy because certain tests prove it to be of less tensile strength than Portland?

It is often claimed for cement that it proved stronger than brick or stone with which it was laid, and that in taking down old work the brick or stone had to be chiselled through, but the cement would not part from it even then. This quality can be honestly claimed for good natural cement, and can also be claimed for Portland, but if the latter is very much stronger than the brick or stone in concrete and costs twice as much as a cement that still compels the chiselling through stone before parting at the points, the sole advantage in the use of Portland is to the manufacturer of it, for the use of a bond stronger than the material to be bonded would seem to answer the question of the necessity of using Portland in the asking of it.

Respectfully yours, C. M. Harris.

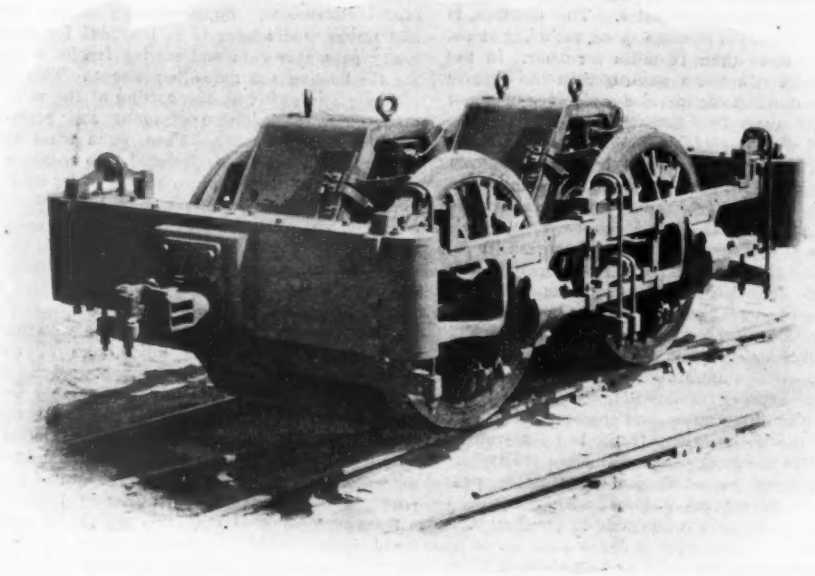
New York, Nov. 14, 1894.

POWER HOUSE AND ELECTRIC LOCOMOTIVES FOR THE BALTIMORE BELT RY.

A great deal has been written and printed during the past few years concerning the substitution of electric locomotives for steam locomotives in ordinary railway service, and the builders of electric motors for street railway service have been gradually increasing the size of their motors and competing successfully with steam locomotives on street and suburban lines, on mine tramways, on local freight spurs, and even on elevated railway service. We are soon to see the first example of an electric locomotive moving the regular freight and passenger trains of a steam railway, and the results of this new departure will be watched with great interest by all engineers. As most of our readers know, the place where this new departure is to be made is on the new "Belt Line" tunnel of the Baltimore & Ohio R. R., in Baltimore, Md., by which trains will enter that city without the ferry transfer, which has always been in use heretofore.

This new belt line and the double-track tunnel under Howard St., one of the largest soft ground tunnels ever driven, have all been fully described and illustrated in past numbers of Engineering News (June 28, 1890; Dec. 12 and 19, 1891; Jan. 16, 1892, and May 18, 1893). The present article is the first authentic published description of the plant and machinery now being installed for the movement of trains through this tunnel by electricity.

The power house which will furnish the electric current for the locomotives and also for lighting the tunnel is located upon the west side of Howard St., between Henrietta and Montgomery Sts., two blocks south of the old Camden station of the B. & O. The building is now approaching completion; the side walls are rapidly going up; four of the foundations for the Allis compound engines are completed, with the exception of the cap stones; the boiler house is being roofed, and the boilers are being erected. The general dimensions of the building and the arrangement of the machinery are shown in the accompanying plan. The building is one story high, 30 ft. from floor to eaves, with side walls of brick, 1 ft. 5 ins. thick. Having iron roof trusses and a slate roof, the building will be practically

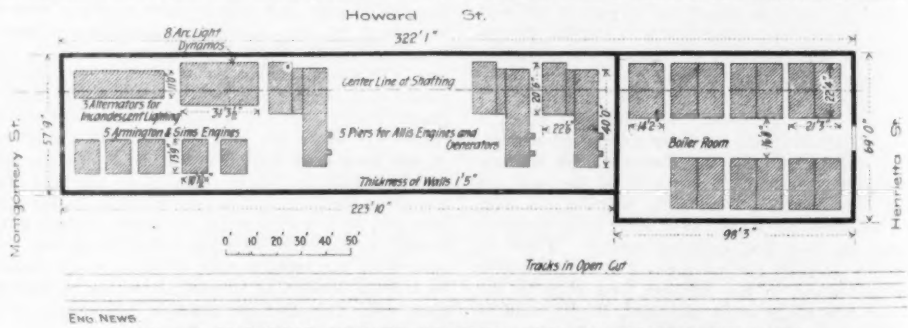


VIEW OF ONE TRUCK OF 1,200-HP. ELECTRIC LOCOMOTIVE FOR THE BALTIMORE BELT RY.
The General Electric Co., Schenectady, N. Y., Builders.

fireproof. Lighting is well provided for by large windows 7 × 17 ft. and three ventilating skylights in the roof, two in the engine room, 65 ft. each in length, and one in the boiler room of 49 ft.

The boiler house will contain twelve 250 HP. Abendroth & Root water-tube boilers set in six batteries. Each boiler is 12 tubes wide and 11 tubes high and has six 14½-in. drums and a 30-in. steam drum. The boiler room is equipped with a mechanical coal crusher and conveyor, and the Hawkins mechanical draft system. The stack will be of iron, 50 ft. high and 10 ft. in diameter. Pumps of the Dean duplex type for boiler feeding and a 3,000 HP. Webster feed-water heater will be used.

In the engine room space has been provided, first, for foundations for five Allis-Corliss compound tandem engines with 24 and 40 × 42-in. cylinders, direct



PLAN OF ELECTRIC POWER STATION FOR BALTIMORE BELT RY.

connected to five multipolar General Electric generators, with a voltage of about 700. These foundations are built of brick, with a 12-in. concrete base, and extend 9 ft. 6 ins. below the floor level. These generators will furnish the current for the electric locomotives. The engine room also contains a lighting plant, consisting of eight 50-lamp arc dynamos, belted to two Armington & Sims cross-compound 250-HP. engines, 16½ and 23 × 19 ins. There are also three alternators, driven by three more Armington & Sims engines of the same size, and these furnish current for 2,000 incandescent lamps, of which about half will be used for lighting the tunnel.

The main wires within the building and extending to a point at which junction is made with the overhead cables, will be laid in the Edison underground tubing, which has been used extensively in all our large cities for general underground wiring for lighting and power and which is now coming into use for railway feeders. The switchboard will be located near the east end of the fourth generator, and from here the positive wires will be piped to the first structure post outside. The three cables in the tube surrounding the pressure wire are first wrapped separately with rope, and then the three together are wrapped and then introduced into the tubing, which is afterward forced full of insulating compound. This mode of insulation provides for the use of the cables separately, if desired, though it is not now intended so to use them.

As increased traffic makes it necessary, four tracks will be laid outside of the tunnel, although only two will be laid at present, this number being continued throughout the length of the tunnel. The electric locomotive will run upon a siding at the beginning of the long open cut near the south end of the tunnel and close to the power house. Freight trains will be switched from the main tracks south of the Camden station into the cut and the electric locomotive will run up behind and couple on without the train's stopping. The steam locomotive will do no work while inside the tunnel, the electric locomotive alone pushing the train from the south end of the tunnel to the entrance at Mount Royal Ave., a distance of 8,146 ft., up a grade of about 0.8% at the maximum. After passing out of the tunnel, the remaining distance to Huntingdon Ave., with a heavier grade, calls into play both locomotives. The speed of these freight trains will be about 15 miles per hour.

For passenger service the electric locomotive will pull the train, instead of pushing it, and a speed of 30 miles will be maintained. In this case the electric locomotives will run only from the Lombard St. station, near the south end of the tunnel, to the Bolton St. station, at the north end. Two of these electric locomotives will be used at first, each weigh-

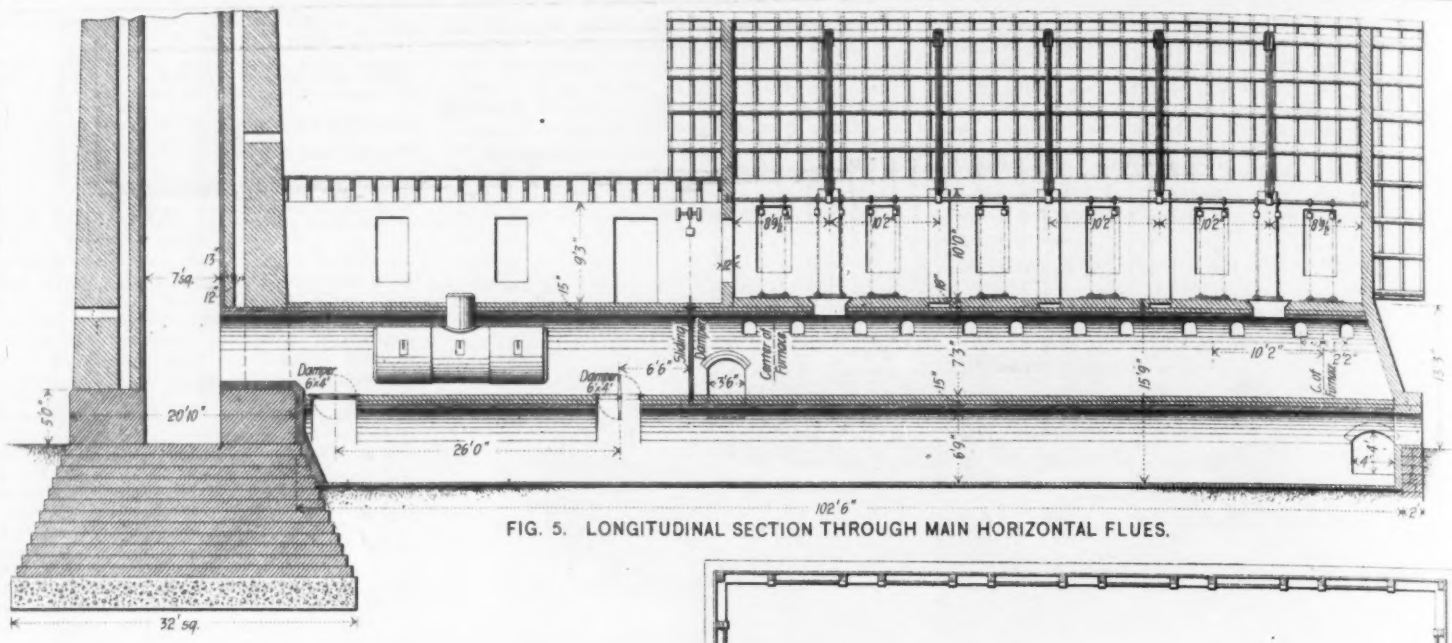


FIG. 5. LONGITUDINAL SECTION THROUGH MAIN HORIZONTAL FLUES.

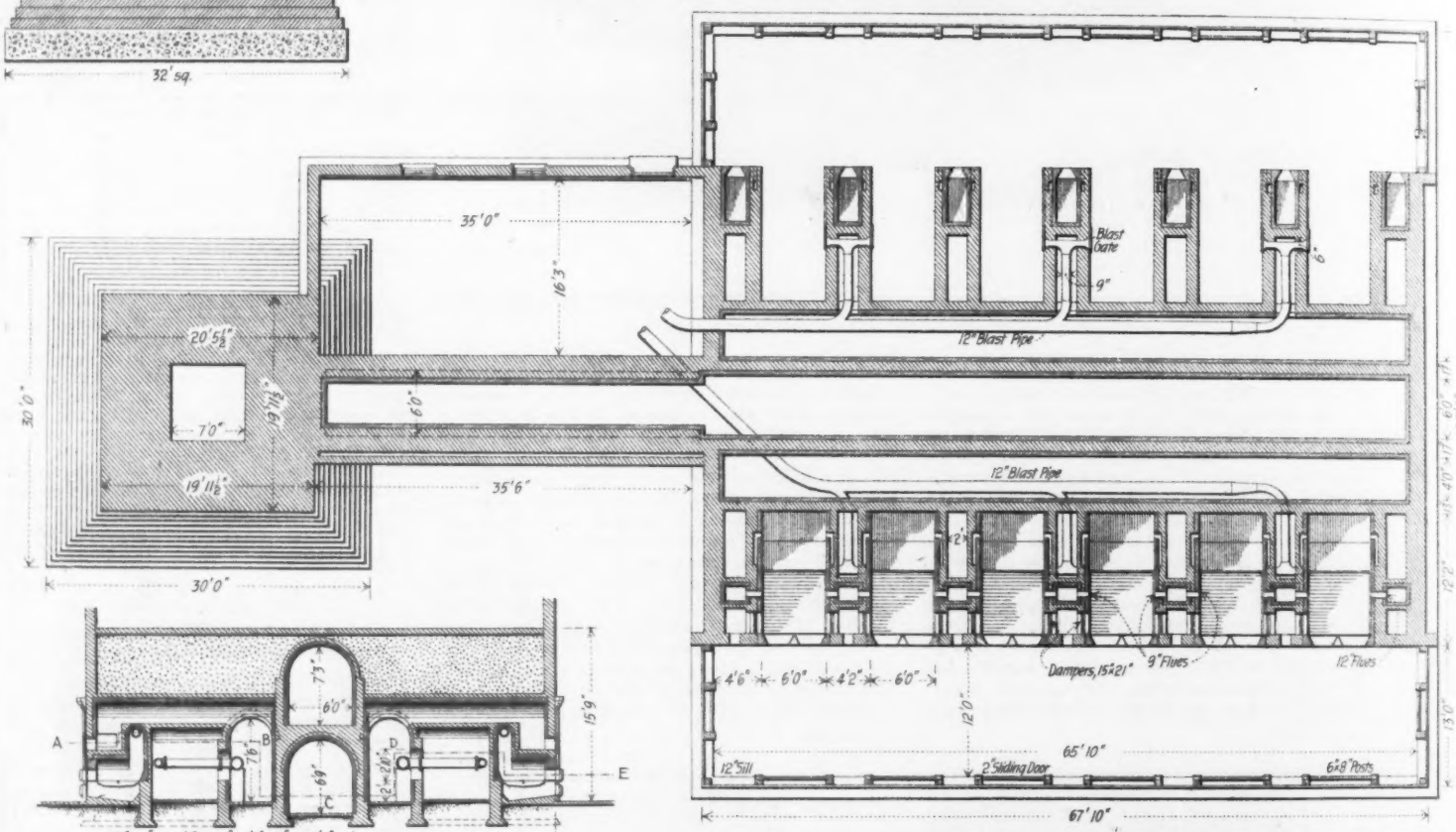
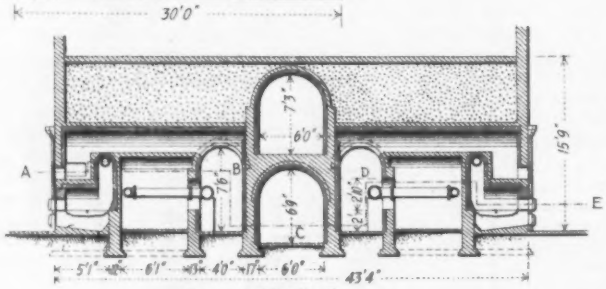
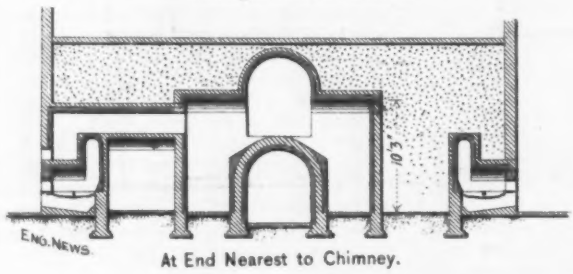


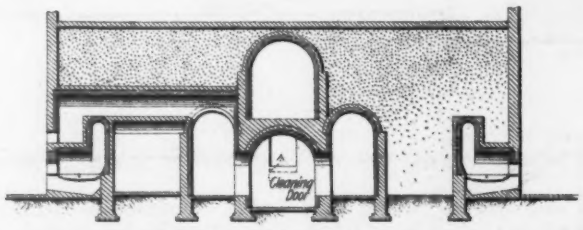
FIG. 1. SECTIONAL PLAN THROUGH LARGE AND SMALL FURNACES ON LINE A B C D E.



Through Middle Furnaces.



At End Nearest to Chimney.



At Far End Looking from Chimney.

FIG. 3. CROSS-SECTIONS THROUGH SMALL FURNACES.

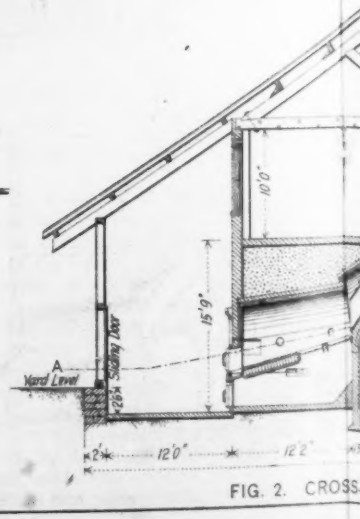


FIG. 2. CROSS

THACKERAY GARBAGE INCINERATOR FOR THE CITY OF MONTREAL.

Charles Thackeray & Co., Engineers and Contractors.

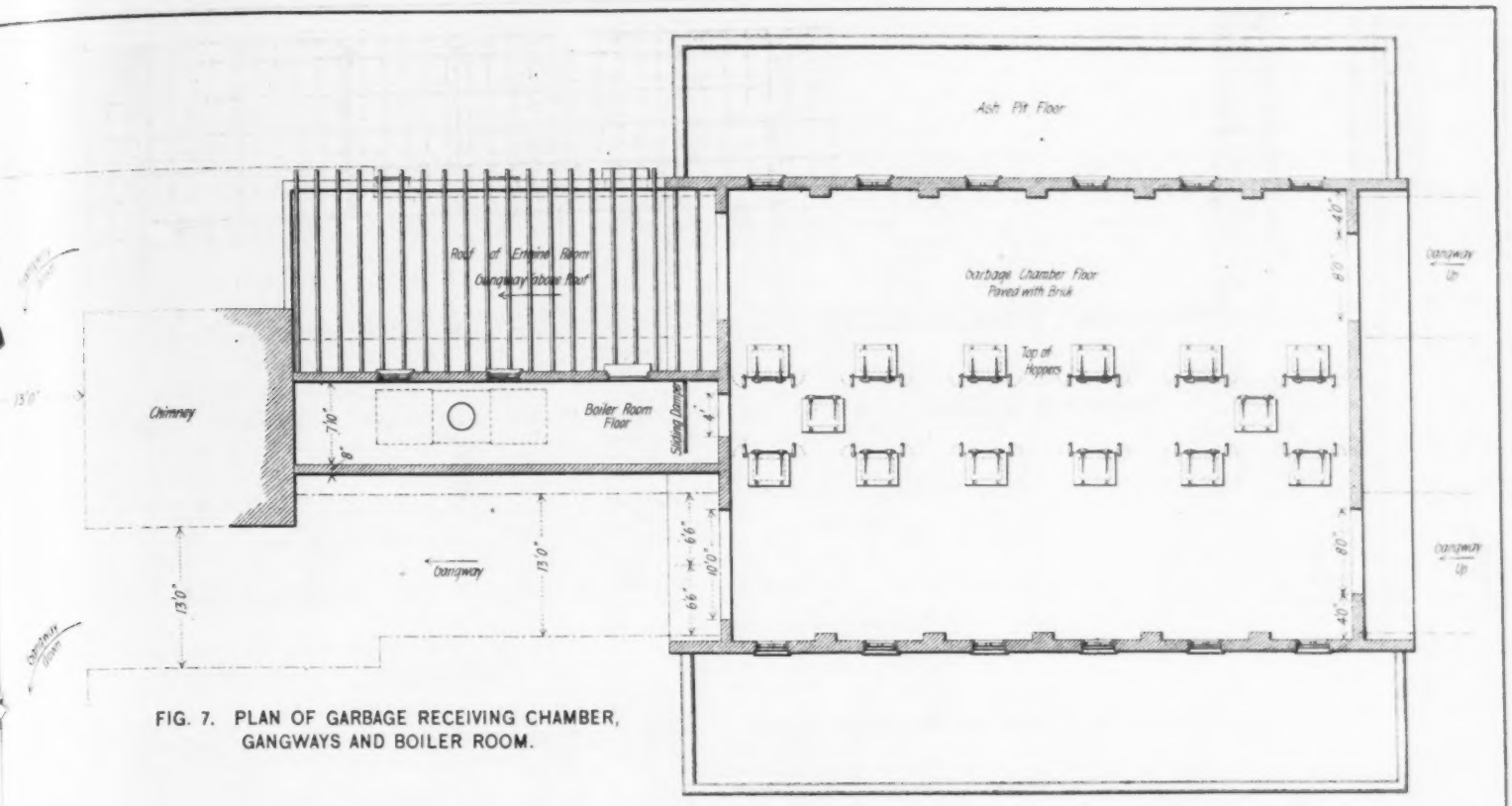


FIG. 7. PLAN OF GARBAGE RECEIVING CHAMBER, GANGWAYS AND BOILER ROOM.

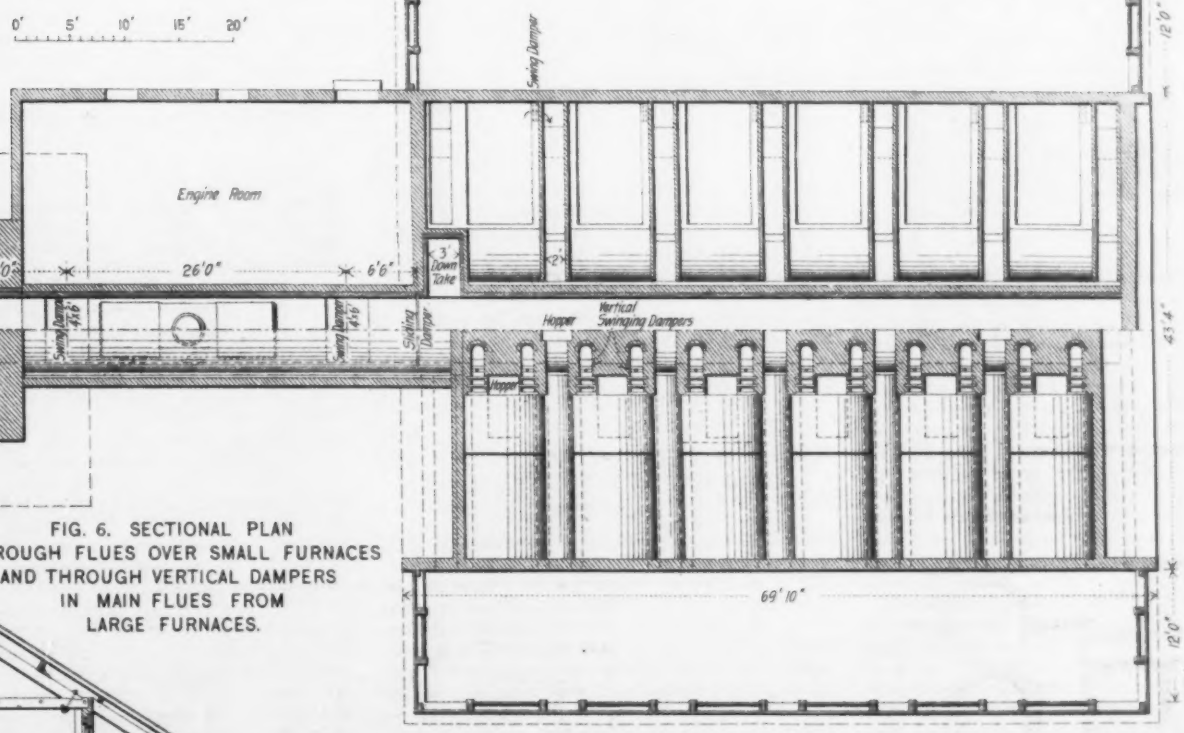
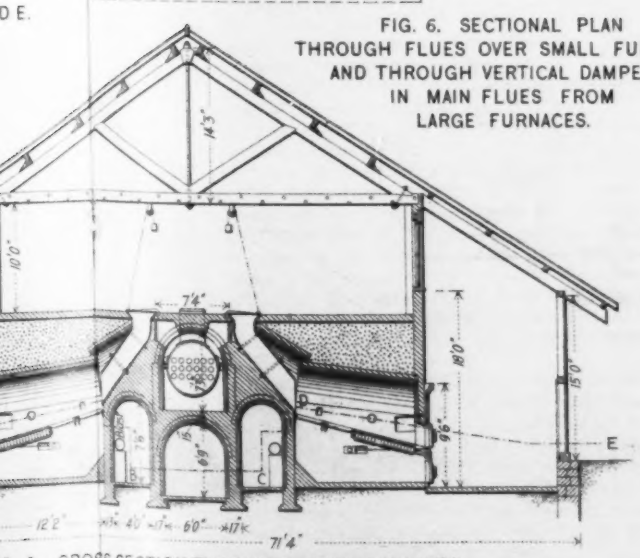


FIG. 6. SECTIONAL PLAN THROUGH FLUES OVER SMALL FURNACES AND THROUGH VERTICAL DAMPERS IN MAIN FLUES FROM LARGE FURNACES.



G. 2. CROSS-SECTION THROUGH LARGE FURNACES.

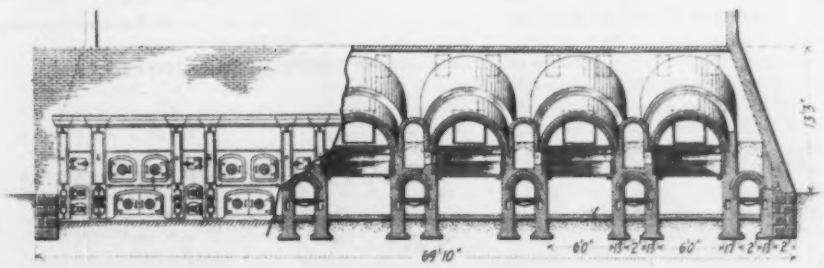
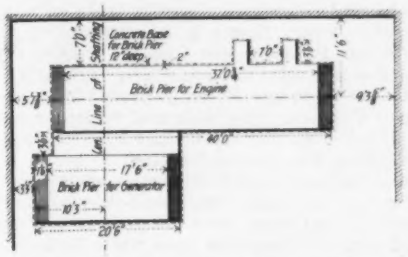


FIG. 4. CAST IRON FRONT AND LONGITUDINAL SECTION THROUGH FURNACES.

CHAS. HART & SONS, LITH., 20 VESEY ST., N. Y.

ing 95 tons. Each will have two four-wheel trucks and connected to each axle will be a 320-HP. motor, wound to take with safety a 700-volt current, though nominally only 550-volt machines. These locomotives will be provided with air-brakes, the air being compressed by a small auxiliary motor, located in the cab. Their normal tractive power is 32,000 lbs. The motors, which are gearless, will be supported upon the truck frames by spiral springs, a mode of suspension which prevents shocks from irregularities in the track. The motors are controlled by series-parallel controllers, located inside the cab.

These locomotives are now being tested at Schenectady and will be shipped to Baltimore during



Foundations for Allis Engine and Direct-Connected Generator in Power Station.

the next few weeks and set up there. The accompanying engraving is reproduced from a photograph of one of the locomotive trucks with the motors in place.

The conveyance of current to an electric locomotive of such great power is something never before attempted, or even approached, and much interest, therefore, attaches to this part of the plant. The overhead contact system will be used both within and without the tunnel. The whole distance to be run by the electric locomotives is 14,500 ft., comprising two tunnels 265 ft. and 7,300 ft. long respectively, and 6,935 ft. of track outside. In general the locomotive will take current from an overhead channel of two Z-bars, in which slides a brass shoe connected by a flexible copper cable with the locomotive.

In detail the current-distributing apparatus is as follows: At intervals of 15 ft. along the tunnel supports are fastened to the roof. Each support consists of two galvanized iron bolts, one on each side, cemented into the roof of the tunnel and carrying porcelain insulators on their lower ends. By these insulators are supported two channels with their flanges facing, extending transversely across the roof of the tunnel. The supporting bolts are 2 ft. 6 ins. long, have split ends and extend 12 ins. into the masonry roof of the tunnel. From these transverse channels a trough of ⅝-in Z bars is suspended over each track. The trough is hung by bolts passing through porcelain insulators clamped between the channels. Thus a double system of insulation is provided, and if leakage occurs, it can only be by the current passing the insulator between the trough and the transverse channel and then the insulation between this channel and the bolt in the tunnel roof. It will also be seen that there may be a defective insulator either on the roof bolt or on the bolt which suspends the trough without loss of current. Leakage will only occur when two insulators on the same transverse support are defective.

The longitudinal troughs overhead outside the centers of their respective tracks, but well toward the center line of the tunnel, so that brakemen standing on the roof of freight cars will not be likely to be struck by the trough. As a further precaution a wooden shield is attached to each trough on the outer side and fastened to it every 15 ft. by a stirrup. It is not, however, insulated from the trough.

To support these overhead troughs outside the tunnel, light posts, made of latticed steel channels, are erected on each side of the tracks every 150 ft. and support an overhead girder spanning the two tracks. Suspended between these cross girders are chains of iron rods, and vertical rods dropped from these chains at intervals of 15 ft. support transverse channels through an insulator between the flanges in the same manner as in the tunnel.

Each of these chains of suspended rods is made of a double line of rods, and on curves these two lines are separated several feet and swing in two parallel curves. This admits of obtaining points of suspension for the transverse channels approximating more nearly to the curve of the track.

To further perfect the insulation of this overhead work, these suspended chains are each insulated at their points of attachment to the cross girders. This is effected by supporting the chain upon a short wooden block or post resting on the girder, instead of attaching it directly to the girder. A hood of galvanized sheet iron over this block protects it from moisture. It will thus be seen that on the outside work three separate insulations must be passed if leakage of current occurs.

The bare copper wires, with which contact is made, are laid in these overhead troughs, and the current is collected from them by a brass shoe of shuttle form with a large contact surface. The shoe is pulled along the trough by a copper cable, which also transmits the current to the motors on the locomotive. The feeder cables which convey the current to the wires in the troughs are each made up of 90 strands of No. 10 bare copper wire, forming a cable 1.17 ins. in diameter.

The insulators for the primary wires of the lighting circuit within the tunnel are porcelain knobs, fastened to wooden blocks bolted to the masonry. The lead-covered cable rests upon these insulators, and at the points of support is wrapped with heavy tin wire, to prevent its being abraded by friction. For the wires of the secondary circuit, porcelain cleats fastened to wooden blocks are used. These blocks are placed upon either side of the tunnel, about 8 ft. from the ground, and 15 ft. apart, but staggered so that they occur alternately every 7½ ft. throughout the tunnel. Each block, at its lower end, supports a lamp and is cut out at the point of attachment of the lamp, so that the socket is well protected from moisture and from any dripping water on the tunnel walls. The lamps used are 32-c. p. Edison lamps, taking a 52-volt. current.

The absence of smoke in the tunnel will make it possible to paint it white, and the brilliant illumination afforded by the incandescent lamps will make it unnecessary to light the lamps in the cars when passing through it. This absence of smoke will prevent the suffocating atmosphere so usual in long tunnels.

The tracks will be laid with an 85-lb. rail, double bonded with No. 0000 copper wire. Return wires of the same type as the overhead feed cables will be laid in a wooden box underground, between the tracks.

None of the work of overhead construction has as yet been finished. The workmen have just begun to put in the supporting bolts throughout the tunnel. The work will be pushed as rapidly as possible, but it will probably be several months before everything is in complete running order.

THE THACKERAY GARBAGE INCINERATOR FOR THE CITY OF MONTREAL.

(With inset.)

The high degree of heat necessary for the perfect combustion of garbage and the consequent temperature of gases escaping to the chimney early suggested to the English builders of garbage furnaces, or destructors, as they are called there, the desirability of utilizing this heat in some way. Accordingly boilers are now included in some of the English garbage plants and the steam developed is used for various purposes.

The first plant this side of the Atlantic in which an attempt is being made to utilize heat which would otherwise go to waste was put in operation some two months ago at Montreal. This plant is designed to consume the garbage of one of the three districts into which the city is divided and has been built by Chas. Thackeray & Co., of 145 St. James St., Montreal. The plant was built for a capacity of 150 tons of mixed refuse, that is, garbage, ashes, street sweepings and everything the carts collect, without sorting. We are indebted to Mr. Thackeray, of the above firm, and to Mr. E. S. M. Lovelace, also of Montreal, for the information here given regarding the Montreal furnaces, or incinerators, as Mr. Thackeray calls them.

Like some of the English destructors, the furnaces at Montreal are placed back to back and the refuse is fed from the collecting carts directly into a hopper, which reaches almost to the grate bars. By this method of feeding all handling of the crude garbage after it is unloaded is obviated, while the location of the hopper in relation to the furnace flues and ash pit tends to dry the garbage before it reaches the fire.

The construction of the furnace is shown by the several plans and sections on the inset sheet. There are 12 large and 14 small furnaces, placed in pairs, back to back, as may be seen by the sectional plan Fig. 1, and the cross-sections, Figs. 2 and 3. The large furnaces are fed from the top, as described above and as shown on the plan, Fig. 7; the small ones, which are between, and the flues of which connect with, the large ones, are fed from the front, and are intended to burn the most refractory substances received, their small size and position between the walls of the large furnaces being designed to give them a high heat and a powerful draft. The large furnaces are provided with patent rocking bars, worked by hand levers placed at the front of the furnaces.

There are two main horizontal flues, shown in the longitudinal section, Fig. 5, placed one above the other, and by-pass flues at each side of the main flues. A boiler for utilizing the heated gases before they pass up the chimney is placed in the upper flue and a fume incinerator, not shown in the drawing, in the lower flue. Blast pipes are placed in the by-pass flues, Figs. 1, 2 and 3, and thus the air forced through them by a 90-in. fan is heated before entering the furnaces.

Ordinarily the gases of combustion enter the top main flue through two small flues, one on each side of the feed hopper, and pass through the boiler to the furnace. If it is desired to treat the gases with steam for the purpose of destroying any objectionable germs which have not succumbed to the dry heat, the gases may be turned to the front of the large furnaces by closing the vertical dampers shown in the sectional plan, Fig. 6, and steam is admitted through pipes from the boilers. The mixed steam and gases go through passages in the side walls of the furnaces, controlled by horizontal dampers, and enter the by-pass flues, from which they may be delivered to either the top or bottom main horizontal flue. This part of the system seems to be of doubtful necessity and not likely to be put in use very often, unless it has some further use than that named.

When desired the boiler may be cut out for cleaning or otherwise by means of the swinging dampers at each end of the boiler, between the upper and lower horizontal flues and the vertical sliding damper in the main flue in front of the boiler.

The chimney rests on a bed of concrete 32 ft. square, as shown in the inset. It is 200 ft. high and has a flue 7 ft. square. The space between the core and outer walls of the chimney is connected with the outer air at intervals by means of pipes.

The vertical walls of the horizontal main flues are extended up to form a chamber, from which the dampers, feed pipes, etc., etc., of the boiler are operated, as shown in section in Fig. 5 and in plan in Fig. 7. The engine room is at the right of and below the boiler chamber, as shown in Fig. 6, and is about 17 × 36 ft.

The buildings over all are 69⅓ × 125⅓ ft., including the chimney and boiler house in the length, the main part of the building being 67 ft. 10 ins. × 69 ft. 4 ins. The brick furnace walls are carried up at both sides and ends to the roof, but the space in front of the furnaces is enclosed with corrugated iron, the roof being of sheet iron and covering the main building, as shown in the sections, Figs. 2 and 5. Altogether the construction, as shown by the drawings, is of a substantial character.

The method of feeding the furnaces directly from the garbage carts, in addition to saving the labor of rehandling, increases the efficiency of the furnace, for as the garbage passes down the hopper it receives some heat from the flues at either side, as already explained, and in addition by falling upon a grate over the hot ash pit, instead of onto a dead hearth, the garbage is further dried and heated before it reaches the fire. Mr. Thackeray claims that by these means the garbage is dried at least 25% quicker than it would be in the English Fryer destructor.

The official report on the test of the plant is given in full below, as follows:

Official Test of the Thackeray Incinerator.

Montreal, Nov. 19, 1894.

To the Chairman and Members of the Health Committee.

Gentlemen: The undersigned were appointed by the council as experts to report and make a test upon the Charles Thackeray Incinerator, built on Gregory farm by order of the council for the city of Montreal.

The contract calls upon the contractor to build an incinerator of 12 cells, which will consume 150 tons of refuse in 24 hours at a cost of 90 cts. per hour. (14.4 cts. per ton.—Ed.)

We beg to inform you that from Monday, Nov. 5, up to Sunday morning, Nov. 11, the amount of refuse consumed was 811½ tons. The contract called for 700 tons in that time, according to the number of cells that were used, namely: Two days, 8 cells, and four days, ten cells, making 111½ tons in excess of what the contract calls for. We could not have all the loads weighed on account of not having the scales supplied us on the ground which we had asked the Health Committee to give us, and consequently we had to have about 50 loads weighed on the public scales as a guide.

We would draw your attention to the following items: On Nov. 5, ten cells were in use and the amount burned was 175.63 tons, the contract calling for 125 tons. If there had been enough material to be burned by the whole 12 cells, there would have been burned in the same ratio 215.78 tons, when the contract calls for 150 tons, making an excess of 65.78 tons in 24 hours.

Taking the average of the six days and the amount of refuse consumed, which was 811.5 tons, in the same ratio with all the 12 cells in use and sufficient material to burn, the consumption would be 1,043.36 tons, or 143.36 tons in excess of the contract requirement for the six days.

The cost of burning this material was as follows: Engineer in charge at 15 cts. per hour, and six stokers and two dump-men at a total cost of $27.60 per day (evidently the stokers and dump-men received 12½ cts. per hour.—Ed.), burning in one day 175.635 tons in 10 cells, which would be 215.78 tons in 12 cells, at a cost of $27.60. The contract calls for 150 tons at $21.60 per day, and it actually costs to burn 150 tons $19.18. The contract requires 150 tons per day to cost 90 cts. per hour, or 14.4 cts. per ton.

The average cost for the six days' test was 173.9 tons per day, at $27.60, or 15¾ cts. per ton. But it was proved that the plant can burn the material for 12¾ cts. per ton, which it did on Monday, Nov. 5.

The grate area is 5 × 6 ft., or 30 sq. ft., the cells each burn 14½ tons per day, or 29,000 lbs., equal to 40.27 lbs. per square foot per hour. The Livet generator equals 33 lbs. and at Oldham 25 lbs., and at Glasgow 21 lbs. are burned.

This incinerator in the six days has consumed at the rate of 40.27 lbs. per sq. ft. per hour.

You will note that no fuel has been used on the works, coal or wood, and we have much pleasure in placing these figures before the committee, which we think are most satisfactory in every respect.

We also find that the ashes and clinkers are nonodorous and will be very suitable for roadways or other uses that the council may see fit.

The steam which can be generated from the garbage can be utilized as power for electric light or any other motive power, and is well worthy of consideration.

The workmanship of the construction is first-class in all respects. We would suggest that an extension be built in the delivery platform to facilitate carting.

Yours respectfully,

(Signed.) Percival W. St. George, C.E., City Engineer; J. G. Dore, C.E., City Sanitary Engineer; G. O. Champagne, S.E., City Boiler Inspector.

THE REPORT OF THE NEW YORK GARBAGE COMMISSION.

Garbage disposal in New York city became so perplexing a question last summer that the Mayor, on July 26, appointed an advisory commission to investigate and report on the subject. The members of the commission were ex-Mayor Franklin Edson, ex-Postmaster-General Thomas L. James, Lieut. Daniel Delehanty, U. S. N., Supervisor of New York Harbor; Hon. Chas. G. Wilson, President of the New York Health Board, and Mr. W. S. Andrews, Commissioner of Street Cleaning.

There were submitted to the commission 70 different schemes for garbage disposal, of which 21 were rejected as impracticable. Of the remainder, 17 were for the burning of garbage, ashes and street sweepings in furnaces, one for burning all this material in self-propelling boats, six for burning garbage only, seven for extracting grease from the garbage alone and making fertilizing material from the tankage, the balance being unclassified.

Aside from inspecting the drawings and hearing the advocates of the various systems, the commission visited plants in a number of cities, and Mr. James visited some of the garbage destructors or furnaces used in England.

The continuance of the old system of dumping at sea is considered intolerable, the commission even stating that the garbage could not be dumped within 200 miles from the harbor without contaminating the Long Island beaches.

Some one of the utilization systems, rather than cremation, is advised in the report, which states that, from figures submitted to it by interested persons, the utilization of the garbage by a reduction process would result in 26½% of tankage worth $9.30 per ton, and 3⅛% of grease, worth 3½ cts. a pound. The commission then says:

On this basis, which your commission has no reason to believe to be excessive, the gross daily returns from the 800 tons of garbage collected in this city would be $3,858, or about $4.82 per ton. The estimated gross commercial value of New York city garbage under the system of cremation, based on the figures as given by five separate cremation systems visited and inspected by your commission, is as follows: Average percentage of residuum, 7.4; value per ton, $10; value of daily product, $592.

The commission made the following recommendations:

(1) That dumping city refuse in any waters of the harbor or its adjacent or tributary waters should be absolutely prohibited.

(2) That the ordnance requiring householders to keep separate the garbage or kitchen refuse from ashes and other house refuse should be rigidly enforced.

(3) That all house refuse should be collected in galvanized-iron vessels with tight-fitting metallic covers, and of such size that when full it can easily be handled by one man.

(4) That daily collections of garbage should be made by the city and delivered at the dumping wharves into the temporary storage, or to self-propelling boats of an approved type, furnished by the party having a contract with the city for final disposition of the garbage.

(5) That the garbage should be disposed of by a reduction process, producing fertilizer and commercial grease; that the city should invite competition by the various companies controlling such systems, in order that the greatest benefit to the city may result. As the plant for the reduction of the garbage of this city would necessarily be extensive and costly, a contract for a sufficient length of time should be offered by the city to warrant the investment, say, not less than 10 years, with proper provision for the transfer of the property of the contractor, at fair value, when the contract is terminated. Ample provision should also be made and abundant security required for the performance of the work on the part of the contractor, in a clean, inoffensive and sanitary manner, and removal of the garbage daily from the city to the reduction works, which should be located at a suitable point beyond the city limits.

(6) That a separate collection should be made of the remainder of the refuse of the city not otherwise provided for, which would be used for filling in at Riker's Island or elsewhere, and for the transportation of this material a sufficient number of self-propelled boats of an approved type should be constructed and owned by the city. It should, however, be provided that whenever the whole or any considerable portion of the street sweepings can be disposed of by contract or sale for fertilizing purposes, at a price greater than their value to the city for filling, then such disposition should undoubtedly be made of them.

(7) That the city should adopt metal water-tight covered carts or trucks of a uniform pattern for the collection of all refuse, and mechanical dust-collecting sweepers, when a satisfactory type can be obtained. That whenever the sweeping of the streets causes dust to arise, they shall first be sprinkled.

(8) That each refuse cart or truck depositing its contents should be disinfected and washed out thoroughly before leaving the wharf.

In conclusion, your commission desires to suggest that, if the substance of this report be approved, as little delay as possible should intervene in carrying the recommendations into effect, in order to prevent a recurrence of the serious causes of complaint the past summer. Six months, at least, will be required to make the necessary preparations. While the first cost of the necessary plant to carry out these recommendations will be considerable, your commission is convinced that the public good demands it; that the scheme here outlined, fully carried out and properly administered, will abate the nuisances so long complained of and place this city in the front rank of the cities of the world in the cleanliness of its streets and the sanitary and economical disposition of its refuse.

We understand that the report will soon be printed with appendices containing many detailed figures.

THE WEBBER COMBINED BRAKE AND FENDER FOR STREET CARS.

The subject of street car brakes was discussed editorially in our issue of Oct. 18, and the suggestion was then made that there seemed to be nothing impossible in the design of an efficient brake operated by purely mechanical means with neither electrical nor fluid transmission of power. We illustrate herewith the Webber band brake for street cars, which is being brought out by the American Railway Maintenance Syndicate, of New York, and which may be used either as the regular brake or as an emergency brake, though it is recommended for the former. It will be seen from the drawing that the action is positive and immediate, as there is no slack to be taken up. It can be applied by a hand lever or a treadle. The brake and fender are now being fitted to a car of the Electric Traction Co., of Philadelphia, Pa., for a service test.

The principal feature of this brake consists in an arrangement of toggle arms, operated by rods connected with the brake lever, which arms are connected with friction straps upon which brakeshoes are fastened and which are attached to a bar actuated by the toggle arms. In applying the brake the toggles are straightened out, depressing the bars connecting the ends of the straps and thus bringing the brakeshoes in contact with the tread of the wheel (including its flange, if desired) or with the surface of a supplemental wheel or brake drum, fastened in a suitable manner to the wheel proper. The brakes are applied directly on the top of the car wheel (or the supplemental wheel), so that fully half the circumference of the wheel is secured for the brakeshoe to act upon, as compared with the smaller surface used in ordinary brake devices.

In the cut the brakeshoes are shown as applied to supplementary wheels attached to the wheel proper, which wheels can be renewed at much less expense than the cost of car wheels. The connecting or brake rods are provided with turnbuckles, so that lost motion and wear may be taken up and adjustment effected. The upper member of each set of toggles is pivoted to the upper end of a bracket, which is bolted to the truck frame, there being a bracket for each set of toggles, and the lower member of each pair of toggles engages with a horizontal bar, there being one such bar on each side of the car, to the ends of which the friction straps are attached. The actuating rods are provided with strong pins opposite the knuckles of each pair of toggles, and these pins pass through the meeting ends of the toggles and form their axis. These rods, at the point where these pins engage, are made sufficiently strong and rigid to withstand the considerable strain to which they are subjected. Under the lower member of each toggle is a spring which returns the parts to their normal position, with the brakes off.

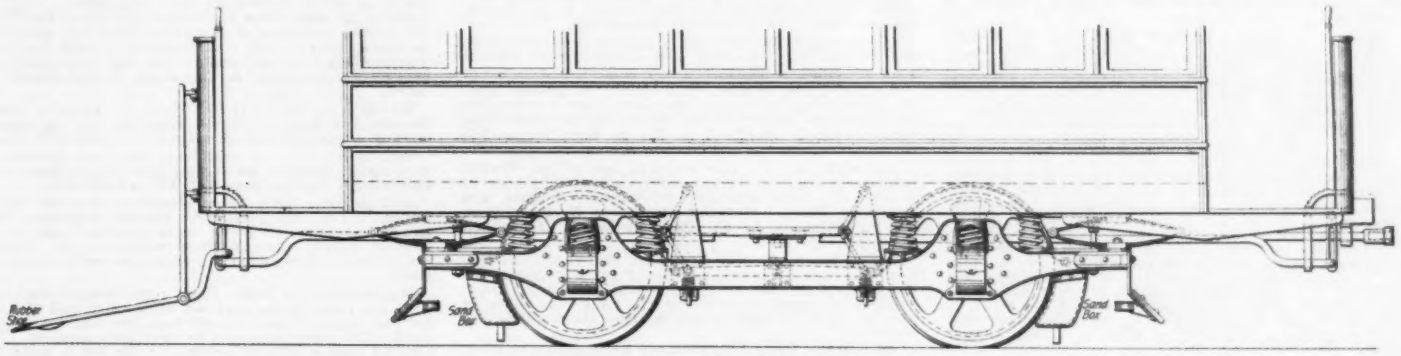
The sand box is connected with the brake gear in such a manner that it only delivers sand to the track when the brake is applied with full force, thereby using the sand only when necessity may require, in order to stop the car instantly and prevent accident. In this way no additional act on the part of the motorman is required to apply the sand, in the event of accident. The sand should, of course, be delivered as closely as possible under the wheel, and in the application to the car at Philadelphia the sand box will be placed under the seat of the car and the discharge pipe will run towards the wheel.

As an extra precaution against accidents, and as there may be occasions when a person will suddenly step in front of a car, an adjustable fender is provided, working in connection with the brake, as shown on the drawings. This fender is lowered simultaneously with the application of the brake, it being impossible to apply the brake forcibly without at the same time depressing the fender, and placing it in proper position.

The fender is constructed in two sections. The first or vertical section, parallel to the dashboard, is a steel frame with a supporting rod in the center, to which are attached hooks that engage eyes on the dashboard, thus allowing the fender to be transferred to either end of the car. The second, or front section, is a horizontal steel frame pivoted to the

vertical section, and when in its normal position is inclined towards the rails and paving between the rails, leaving a clearance of several inches. The front rod of this section is covered with a heavy rubber shoe, substantially made and in the form of a wedge, the front or thin edge of the wedge extending some distance out from the front rod, and, when in position for action, as a case of impending accident, or when the brake is applied with full power, which is only necessary in such a case, the rubber-faced edge is brought in direct contact with the rails and paving between the rails, thus making it practically impossible for the fender to pass over an obstruction, even the limbs of a prostrate form. The whole fender is covered with a pliable network of sufficient strength to receive and retain the weight of a heavy person. The first duty and impulse of the motorman or brakeman on a car on seeing a person in danger of being run over by his car, is to apply the brake as rapidly and forcibly as possible. After doing this, he would, in most cases, have no time available to operate an independent mechanism for depressing the fender, even if he had the presence of mind to do so. With this fender no second movement is required. As soon as the brake is applied the front section of the fender is depressed until its flanged wheels engage with and rest on the rails. In passing round a curve the front section is depressed in the same way by the action of the brake, which is usually applied when going round a curve, and by the action of the wheels engaging with the rails, the fender turns upon the hooks by which it is attached to the dashboard, and is kept in proper position between and parallel to the rails. When the curve is passed the brake is released and the fender raised, whereupon the tension springs return it to its normal position.

The position of the levers operating the front section can be so arranged that they will not be affected unless the brake is applied with full power, as in case of impending accident. By this means a slight amount of brake power can be applied without operating the fender lever, as in cases where it may be desired only to check the speed of the car slightly.



THE WEBBER COMBINED BRAKE AND FENDER FOR STREET CARS.

WATER PURIFICATION IN AMERICA.

(Continued from p. 156.)

Results Obtained in 1893 at the Lawrence Experiment Station.

A detailed account of the work of the several experimental sand filters for water purification at Lawrence during the year 1893 is presented in the last annual report of the Massachusetts State Board of Health. The investigations have been conducted along the lines followed in 1892, as described in Engineering News of Nov. 30, 1893. In general the results for 1893 confirm those of the previous year except that they seem to indicate that a higher rate of filtration than 2,000,000 gallons per acre per day may be employed in some cases with good results, and that continuous filtration is more promising than has been thought hitherto and more nearly equal in efficiency to the intermittent application of water.

In our issue for Oct. 4, 1894, there appeared a paper by Mr. Geo. W. Fuller, the biologist in charge of the Lawrence work, which set forth very fully the present status of the investigations. This paper, with last year's review of the work, mentioned above, leaves little to be said here, except to call attention to a few points and give some figures regarding the amount of sand necessary to be removed from the filters to prevent clogging.

It appears that the efficiency of the filters for the removal of bacteria may be maintained, just after scraping, at nearly the maximum if care is taken not to disturb the main body of the sand by rapid refilling with water, either from above or below. One means of avoiding this is to drain the filter only slightly below the surface prior to scraping. It also appears that loss of head through clogging does not seriously affect the removal of bacteria, although, of course, it reduces the rate of filtration. Both these points are at variance with common belief abroad, but perhaps this belief would change with the adoption of the careful manipulations employed at Lawrence.

Mr. Fuller believes that the necessary frequency of scraping increases with the fineness of the material and the loss of head; also that as the filters grow old the sand becomes more compact, which, with the accumulation of matter, gives the effect of finer material and increases the frequency of scraping. Under the present methods of operation, intermittent filters require scraping less frequently than continuous, owing to the stirring up of the surface by the air drawn into and driven from the intermittent filter.

The frequency of scraping and the amount of sand removed from May to November, inclusive, 1893, are shown for each filter by the accompanying table, which also gives the characteristics of each filter. The size of the sand grains in inches is added for the convenience of our readers. It may be stated here that many of the results for 1893 are for the period from May to November, only, owing to complications from freezing during the winter months, which allowed the water to run down spaces between the sand and the iron tanks. It was thought, apparently, that with different manipulation this freezing might have been avoided and, therefore, that the results during this time should be excluded.

Summary of Results of Scraping of Experimental Water Filters at Lawrence, Mass., May to November, 1893.

Filter.	Effective size of sand grain.* mm.	ins.	Approximate depth of sand. ins.	Maximum loss of head, ins.	Method of operation.	Number of scrapings.	Av. depth removed at each scrap'g, ins.	Water filtered per acre between scrapings, gallons.	Sand removed per million gallons, cu.yds.
33 A	.14	.06	60	70	Continuous.	8	.23	49,000,000	.63
34 A	.09	.04	45	70	Continuous.	17	.12	14,000,000	1.16
35 A**	.20	.08	48	70	Intermittent.	3	.25	92,000,000	.36
36 A**	.20	.08	48	70	Continuous.	7	.21	35,000,000	.82
37**	.20	.08	55	70	Continuous.	1	.20	141,000,000	.19
38	.20	.08	20	35	Continuous.	18	.17	22,000,000	1.06
39**	.20	.08	1	23	Continuous.	14	.15	13,000,000	1.55
41	.14	.06	60	70	Intermittent.	8	.19	56,000,000	.46
42	.20	.08	10	23	Continuous.	24	.16	19,000,000	1.11
43	.26	.10	60	70	Continuous.	16	.26	57,000,000	.63
44	.29	.12	60	70	Continuous.	13	.30	70,000,000	.58
45	.23	.09	60	70	Intermittent.	4	.28	78,000,000	.48
46	.29	.12	12	23	Continuous.	5	.25	29,000,000	1.16
47	.29	.12	60	70	Intermittent.	2	.45	100,000,000	.60
48	.38	.15	60	70	Intermittent.	1	.88	181,000,000	.66
49	.38	.15	60	70	Continuous.	4	.32	79,000,000	.53

* 10 per cent. of grains these sizes or less. ** Nos. 35 A and 36 A were complicated by loam layers. No. 37 was scraped but once, and during a portion of the period channels were formed at the sides. For a short time Nos. 36 A and 39 were run intermittently, while No. 35 A was operated continuously for a brief period.

CONSTRUCTION NEWS.

RAILWAYS.

East of Chicago—Existing Roads.

BELLAIRE, ZANESVILLE & CINCINNATI.—J. K. Geddes, Ch. Engr. and Gen. Man., Zanesville, O., writes us that the Muskingum road, recently purchased by this company, has just been changed to standard gage by the addition of a third rail, 9 miles in length, and 1 mile of the B., Z. & C. proper, making 10 miles of 3-rail track. No final arrangements have been made for broadening the gage of the remainder of the line, some 112 miles in length.

BELLEFONTE CENTRAL.—Press reports state that the Stone Valley people offer to give $75,000 if this railway is extended to Huntingdon, Pa.

LOTBINIERE & MEGANTIC.—J. T. Morkill, Engr. and Supt., writes us that 23 miles of this railway are completed and that the inauguration ceremonies were to take place Nov. 22. The line extends from Lyster Station, Megantic county, on the Grand Trunk, to St. Philomene, Lotbiniere county, Quebec, 11 miles being constructed in 1893 and the remaining 12 miles in 1894. D. G. Loomis & Sons, Sherbrooke, Que., were the contractors.

NEW YORK, ONTARIO & WESTERN.—Press reports state that this company has definitely located the route for the Ellenville branch from Ellenville, N. Y., to Napanoch and the Eastern State Reformatory. The new road will be built on the east side of the Delaware & Hudson Canal. It is expected that work will be begun about Jan. 1. Surveys have also

been made down the Rondout Valley for a further extension to Alligerville and Creek Locks. This will be built if the managers of the road are satisfied that enough business can be secured to warrant the extension.

PENNSYLVANIA & NORTHWESTERN.—The Altoona., Pa., "Mirror" states that S. Cameron Corson, Engr., has been engaged to superintend the laying out of a branch of this railway several miles in length in the vicinity of McGee's Mills.

Projects and Surveys.

HAMILTON RADIAL.—This company proposes to build a network of electric and steam railways radiating from Hamilton, Ont., and connecting with the more important cities and towns of western Ontario. An officer of the company is reported as stating that the plans include 228 miles of railway, including a steam road to Niagara Falls and Buffalo, N. Y.

INDIANAPOLIS, BLOOMINGTON & BEDFORD.—Newell Sanders, Pres., Chattanooga, Tenn., writes us that surveys have been made for this railway from Indianapolis to Bedford, Ind., 80 miles, and most of the right of way secured. Some $130,000 cash aid has been voted along the route, and the company is now waiting for a market for the bonds.

Southern—Existing Roads.

ATLANTIC COAST LINE.—This company is reported about to spend $40,000 in terminal improvements to the Norfolk & Carolina road at Pinner's Point, Va.

SAVANNAH CANAL.—The Savannah Canal Co. is reported as building a railway 12 miles in length from Folkston to Camp Cornelia, in the Okefinokee swamp, in the southern part of Georgia. The right of way has been cut and the grading and tracklaying commenced.

Projects and Surveys.

PIONEER MINING.—A report from Thomas, Ala., states that this company is about to build a railway 11 miles in length to coal fields.

SUGAR CREEK, PACK'S BRANCH & PAINT CREEK.—Incorporated in West Virginia, Nov. 21, to build a railway from Sugar Creek, Fayette county, to Paint Creek, Kanawha county; capital stock, $200,000; incorporators: E. Smith, Alderson, W. Va.; W. Smith, Hawks Nest, W. Va.; F. N. Smith, Mount Hope, W. Va.; Wm. Prince and J. F. Prince, Prince, W. Va.

Northwest—Existing Roads.

MONTANA MIDLAND.—The item in our issue of Nov. 8 in regard to the construction of this railway, which was duly credited by this journal to the Helena, Mont., "Independent," was incorrect and premature. Gen. W. A. Haven, Ch. Engr., Helena, Mont., writes us that no such contracts have been awarded, and it is not probable that any more construction will be done until next spring, and he adds that owing to this item he has received an avalanche of applications for positions, from chairman to chief engineer and from brakeman to general manager, and that his stock of catalogues and samples sent by manufacturers and supply agents is sufficient to start a railway supply store.

GREAT NORTHERN.—N. D. Miller, Ch. Engr., St. Paul, writes us that this company at present has not decided upon any construction work for next season and has nothing in contemplation for the public, if in fact it has anything at all.——Press reports state that the Fosston Branch will be built next year and that this extension will shorten the distance from the two Dakotas and Minnesota to Duluth and Superior by about 150 miles.

WYOMING & PIERRE.—C. D. Crouch, railway contractor, Rapid City, S. Dak., writes us as follows: The Wyoming & Pierre Ry. was projected from the city of Pierre and Hughes county, S. Dak., to be built from Pierre, S. Dak., to Aberdeen, S. Dak., 165 miles, to connect with a branch of the Northern Pacific at that point. Bonds were issued by Pierre and Hughes county. A contract with the Northern Pacific provided that said road should be graded and bridged by the projectors under an engineer of its own road, and when so graded and bridged the Northern Pacific would furnish and lay the steel and operate the road to Pierre. The road was about 80 per cent. graded and partly bridged when funds became exhausted in 1892, and no work has since been done. James A. Ward, Pierre, S. Dak., is president and general manager.

Projects and Surveys.

ODELL CITY, HOT SPRINGS & WIND CAVE.—Incorporated in South Dakota Nov. 20 to build a narrow-gage railway from Odell City to Wind Cave, 20 miles; capital stock, $200,000; incorporators, Abel W. Odell, E. B. Cook, Orpha Odell, Evaline Cook, all of Odell City, S. Dak.

Southwest—Existing Roads.

ILLINOIS CENTRAL.—We are officially informed that the various newspaper reports in regard to the construction or purchase of uncompleted roads by the company are wholly incorrect, and that it is not probable that the company will engage in any extensions whatever for several years.——Press reports state that the company is to spend $60,000 in building sidings and wharves for the fruit business at New Orleans, La.

SAN ANTONIO & GULF SHORE.—The construction of this railway between San Antonio and Galveston, 216 miles, is reported as progressing rapidly. Some 70 miles have been located, 40 miles graded and 18 miles of rails laid.

Projects and Surveys.

GALVESTON & GREAT NORTHERN.—This railway, which is projected from Galveston, Tex., to Niobrara, Neb., was noted in our issue of last week. The Sterling, Kan., "Bulletin and Gazette" states that $28,000,000 of English capital has been pledged to build the road, and that the contract for the construction has been awarded to Matthew Hayes, Binghamton, N. Y., actual work to be commenced at Sterling, Kan., about Jan. 1.

PALESTINE & DALLAS.—G. W. Burkitt, Pres., Palestine, Tex., writes us that it is expected to commence the construction of this railway early next spring. The road will be about 110 miles in length.

Rocky Mt. and Pacific—Existing Roads.

CANADIAN PACIFIC.—P. Alex. Peterson, Ch. Engr., Montreal, writes us as follows: We are not letting any contracts of any kind at present. The Nakusp & Slocan Ry. and the Revelstoke & Arrow Lake Ry. are completed. We are doing nothing through the Crow's Nest Pass, nor do we intend doing anything this year. Nothing is decided regarding next year's works.

UNION PACIFIC.—It is reported that surveys are being made for a branch from Melrose, Mont., up Camp Creek about 10 miles and thence up Wickiup Creek about 4 miles to the Anaconda Co.'s mines. There will be no rock work, no short curves and the grade will not exceed 2%, according to the reports. There will be three small bridges on the line. It is stated that the Anaconda Co. has guaranteed 7% on the cost of the road, and that the construction will be commenced very soon.

Foreign.

SOUTH AFRICA.—A press report from Pretoria, South African Republic, states that the last spike of the Pretoria-Lourenzo Marques Ry., the construction of which commenced in 1886, was driven Nov. 24 at the Wilje River.

STREET AND ELECTRIC RAILWAYS.

PORTLAND, ME.—The Portland & Yarmouth Ry. Co. has been incorporated to build an electric railway; capital stock, $200,000; Pres., E. S. Perry, New Haven, Conn.; Vice-Pres., J. O. May, Naugatuck, Conn.; Treas., J. S. Bradley, New Haven.

BENNINGTON, VT.—The legislature has passed bills granting charters to the Bennington Electric Ry. Co. and the Bennington & Woodford Electric R. R. Co.

BRAINTREE, MASS.—The Braintree & Weymouth St. Ry. Co. has accepted the franchise granted by this town.

GLOUCESTER, MASS.—The Gloucester & Rockport St. Ry. Co. has been incorporated with a capital stock of $40,000, to construct a street railway two miles long. Pres., W. B. Ferguson, Malden; Treas., A. D. Bosson, Chelsea; Secy., D. S. Presson, Gloucester.

MARLBORO, MASS.—The Marlboro & Westboro St. Ry. Co. has petitioned for a franchise for an electric road six miles in length.

WEYMOUTH, MASS.—The Quincy & Boston Electric Ry. Co. has petitioned the selectmen for a location from Jackson Square to the station of the New York, New Haven & Hartford R. R., in East Weymouth, through Commercial and Station Sts.

ALBANY, N. Y.—The construction of an electric railway to connect Albany with Castleton by way of Greenbush, with branches to Clinton Heights and Schodack Village, is being discussed. N. R. Wilbur, W. N. Callender, O. F. Hilt and Nelson Davenport, Troy, are interested.

BATAVIA, N. Y.—The New York Standard Construction Co., New York, has petitioned for a franchise for the Batavia St. Ry. Co., which will shortly be incorporated to construct an electric road six miles in length. A. B. Wilgus is representing the construction company.

FLUSHING, N.Y.—The Flushing & College Point Electric R. R., now in the hands of Charles Brown as receiver, is to be extended and new rolling stock purchased, at a cost of $50,000, according to reports.

NEWTOWN, N. Y.—The Newtown Ry. Co. has been granted a franchise to construct an electric railway through this town from Long Island City to Flushing. It is reported that the road will probably be in operation in three months.

PEEKSKILL, N. Y.—The Beach Ry. Co. has been granted a franchise for an electric railway through this village.

WATERLOO, N. Y.—The Geneva & Waterloo Electric R. R. Co. has been granted right of way on Main St.

HADDONFIELD, N. J.—The Jamaica Construction Co. has been incorporated with a capital stock of $100,000. It is proposed to construct an electric railway in the towns of Jamaica and Hempstead, N. Y., and other places; incorporators, Elward Ilsley, W. C. Smith, Philadelphia; John McNeill, Haddonfield.

McKEESPORT, PA.—Patton & Gibson, 531 Wood St., Pittsburg, Pa., have been awarded a contract by the McKeesport & Reynoldton Passenger Ry. Co., to tear up 6,100 ft. of track on Fifth Ave., put in new ballast and new ties, relay the track with 92-lb. girder rails and repave the street. The work was commenced Nov. 19.

OVAL, PA.—Peter Voneida, S. C. Tate, J. V. Ramsey and J. H. Pearson have been appointed to solicit subscriptions to aid in the construction of the proposed electric railway in the Nippenose Valley from Lock Haven to Milton, with probably a branch to Williamsport. Levi Gann, Lock Haven, is interested.

PITTSBURG, PA.—It is stated that W. C. Jutte is at the head of a company that proposes to construct a new inclined railway to the top of Mount Washington. The Monongahela Inclined Plane road now in operation, is reported as inadequate.

BALTIMORE, MD.—The Mount Washington Electric Ry. Co. has petitioned the Baltimore county commissioners for a franchise for a single-track railway two miles in length. G. R. Webb, the president of the company, is vice-president of the Pikesville, Reisterstown & Emory Grand Ry. Co. It is proposed to build the road this fall.

CRISFIELD, MD.—A company has been organized to construct an electric railway from this place to Sterling Springs, a distance of 2½ miles. Pres., T. S. Hudson; Secy., O. P. Byrd.

CUMBERLAND, MD.—The Cumberland Passenger Ry. Co. has been organized and will extend the present road, according to reports. Chn., W. E. Walsh; Secy., W. D. Paisley.

CLARKESBURG, W. VA.—The Clarkesburg & Suburban St. Ry. Co. has been granted a 25-year franchise, work to commence in six months. Directors, R. S. Gardner, L. H. Vance, C. M. Hart and J. H. Horner.

RINGWOOD, W. VA.—The construction of an electric railway from this place to Morgantown, a distance of 25 miles, is being discussed.

COLUMBUS, GA.—Press report state that the North Highlands Electric Ry. Co. and the Columbus St. R. R. Co. have been consolidated. The latter company has recently effected arrangements with a northern syndicate for a thorough equipment of the horse car line and the dummy line to Wildwood with electricity.

NEW ORLEANS, LA.—B. T. Waldo, of Hudson & Waldo, has petitioned for a franchise for an electric or horse railway from Carrollton to Southport, estimated to cost $60,000.

McGHEE, TENN.—It is reported that right of way is being secured for an electric railway from this place to the Chilhowee slate quarries, a distance of 18 miles up the Little Tennessee River. Gen. Hamilton, manager of the Chilhowee Slate Co., is interested.

BOWLING GREEN, KY.—It is reported that bids are being received for equipping an electric railway. Engr., M. H. Crump.

AKRON, O.—The Seiberling Co. has petitioned the commissioners for a franchise for an electric railway from Silver Lake to Kent, by way of Monroe Falls.

LIMA, O.—It is reported that the Lima College people and others have been granted a franchise for an electric railway in the city and to the college grounds.

MOUNT VERNON, O.—F. W. Jones, Pres., Central Ohio Electric Ry. Co., writes us that the company has completed surveys between this place and Mount Gilead, a distance of 23 miles, by way of Fredericktown, Luzerne and Chesterville, and expects soon to have the line located to Marion. The people along the route are much interested in having the road built this winter. Treas., W. M. Koons; Secy., J. A. Caldwell.

WINTON PLACE, O.—The Cincinnati St. Ry. Co. has been granted a franchise for an electric railway through the village, the work to be commenced in 60 days.

TERRE HAUTE, IND.—Press reports state that the county commissioners have ordered an election in Harrison township, Dec. 1, to vote on granting a bonus of $20,000 to the Terre Haute & Brazil Electric Ry. Co. The company is incorporated with $100,000 capital stock, of which $20,000 has been subscribed. The distance is 13 miles from the end of the Terre Haute St. Ry. to the terminus of the Brazil City Ry., and it is estimated that it will cost $125,000 to build the road. The promoters of the project say they can easily get enough subscriptions to the stock if this $20,000 is voted.

MACKINAC ISLAND, MICH.—J. H. Roberts, Grand Rapids, has been granted a franchise for an electric railway around the island, estimated to cost $100,000.

CHICAGO, ILL.—A certificate has been filed to record the increase of the capital stock of the North Side Electric St. Ry. Co. from $500,000 to $1,500,000.

APPLETON, WIS.—The Wisconsin Electric Inter-Urban Ry. Co. has petitioned Neenah, Menasha, Kaukauna and other cities for franchises to construct an electric railway through those towns. J. M. Thompson, Chicago, is reported as owning one-half the capital stock.

MILWAUKEE, WIS.—Press reports state that surveys are being made between Milwaukee and Chicago for the proposed electric railway, for which a capital stock of $10,000,000 is said to have been assured. The electric road is to pass through all the towns along the lake between Milwaukee and Chicago, and will be as nearly an air line as possible. The work of active construction, it is said, will begin early next spring, and will require about a year.

MASON CITY, IA.—J. W. Walsh, representing the Coleman Construction Co., Clinton and Burlington, is investigating the advisability of constructing an electric railway at this place, according to press reports.

HOT SPRINGS, S. DAK.—C. J Stackpole, Harrisburg, Pa., and others have petitioned for permission to construct the Hot Springs & Wind Cave Electric Ry., 12 miles in length. It is stated that this will be an electric railway, and that the power will be furnished by the Water, Light & Power Co. The incorporation of this company was noted under Railways in our issue of Nov. 15.

FORT WORTH, TEX.—Press reports state that the Fort Worth St. Ry. Co. has purchased the North Side Co.'s property for $30,000, and that the new company will spend $50,000 in improvements.

JOPLIN, MO.—It is reported that $3,000 of the $15,000 required has been placed with the county clerk to secure the building of an electric railway from this city to Carthage, Mo.; also that $25,000 has been subscribed by the citizens and that work is soon to be commenced.

SEDALIA, MO.—The Sedalia & Brown Springs Electric Ry. Co. was incorporated Nov. 24 with a capital stock of $80,000; D. C. Metokes, Charles Carroll, Sedalia; W. E. Sterne, Topeka, Kan.

PUYALLUP, WASH.—Press reports states that an ordinance has been introduced into the city council granting a franchise for an electric railway on Meridian St. from Indiana Ave. north to the Northern Pacific R. R., to be completed by Jan. 1, 1896, by W. N. Coler & Co., trustees.

TACOMA, WASH.—The Tacoma Traction Co. has been incorporated with a capital stock of $500,000; incorporators, Stuart Rice, C. S. Fogg and G. B. Blanchard.

TRURO, N. S.—The "News" states that E. Franklin Clements and others are applying to the Dominion Government for a charter for an electric railway between St. Johns, N. B., and Yarmouth, N. S. The route proposed is from Yarmouth, following the shore to Weymouth, thence to Truro, Amherst, and into New Brunswick. Tidal water power is to be utilized,and it is hoped by the promotors to reduce the expense of operating the road to one-half the usual cost of such lines.

HAMILTON, ONT.—Press reports state that W. F. Forsyth, who represents a syndicate of Eastern capitalists, has sent a letter to the council making application for a bonus to the Radial Electric Ry. Co., running from Hamilton to the following points, for the amounts mentioned in connection with each of the several sections: Hamilton to the Niagara River, $100,000; Hamilton to Woodstock, $100,000; Hamilton to Guelph, $125,000; Hamilton to Berlin, $125,000, the bonus for each section of the road to be paid on the road being completed. Car shops and a round house to cost $50,000, and a station to cost $25,000, are to be constructed. It is proposed to use steam between Hamilton and the Niagara River.

ST. THOMAS, ONT.—The new electric street railway company is considering extending the line to London on the north and Port Stanley on the south by the coming summer, according to reports.

ELEVATED RAILWAYS.

CHICAGO, ILL.—The following elevated railway companies were incorporated at Springfield, Ill., Nov. 23: Union Elevated R. R. Co.; capital stock, $5,000,000; directors: Egbert Jamieson, John B. Parsons, John A. Rose, J. William Helm, D. H. Louderback, Le Grand Perce, Edmund Furthmann, Edward Koch and L. D. Condee. Central Chicago Elevated R. R. Co.; capital stock, $3,000,000; incorporators: John Worthy, Marcellus Hopkins, A. L. Gardner, E. C. Nicholls and J. Keffer. Both companies are reported as incorporated to build down-town loops.

BRIDGES.

ST. ALBANS, VT.—The Central Vermont R. R. Co. has contracted with the Rochester Bridge & Iron Wks. to replace six spans of Howe bridges on the Rutland Division. Consult. Engr., Geo. H. Thomson, New York.

TROY, N. Y.—There is talk of building a bridge across the Hudson River to connect with Green Island. The bridge would be similar to the Congress St. bridge, and it would be used by the Troy City Electric Ry. Co. for its Cohoes line, according to local papers.

PITTSBURG, PA.—The following bids were received for the erection of the bridge across the Monongahela River at South 22d St.:

Pittsburg Bridge Co., Pittsburg	$570,000
King Bridge Co., Cleveland, O.	485,000
Penn Bridge Co., Beaver Falls, Pa.	454,000
Edgemoor Bridge Co., Edgemoor, Del.	576,000
Groton Bridge & Mfg. Co., Groton, N. Y.	435,000
Massillon Bridge Co., Massillon, O.	473,800
Schultz Bridge & Iron Co., Pittsburg	399,750

MERIDIAN, MISS.—Bids are asked until Dec. 3 for building a bridge across Cow Creek on the new road from Siding to Susqualena. B. V. White, Clk. Supervisors.

NEW ORLEANS, LA.—L. W. Brown, Cy. Engr., has prepared specifications for an iron bridge over the canal at Hagan Ave.

CINCINNATI, O.—It is reported that the engineering department of the Baltimore & Ohio Southwestern is now busy with plans for new bridges on all of the divisions.

BRAZIL, IND.—A bridge on the Chicago & Eastern Illinois R. R. north of this city was destroyed by fire Nov. 22.

MARINETTE, WIS.—The Milwaukee "Sentinel" states that it has been nearly decided by the councils of Marinette and Menominee to construct an iron bridge across the river connecting the two cities at the present location of the old wooden bridge, to be 1,700 ft. long, 30 ft. wide and to cost $60,000 to $80,000. Estimates will soon be asked for the work and also for a $6,000 wooden bridge near the paper mills.

BELLEVILLE, ILL.—The council is considering the construction of a bridge over Richland Creek, on Main St., to replace the present wooden structure.

ST. LOUIS, MO.—The construction of a bridge is projected over Clark Ave., at the new Union Station. Thomas G. Watts and Henry Steinman have been appointed a committee by property owners to push the matter. The estimated cost to the city is $100,000, and to the Terminal Association about $150,000. An ordinance authorizing the construction of this bridge is now being prepared.

DENVER, COLO.—The following bids were received Nov. 21 for the construction of the proposed 38th St. bridge; Ch. Engr., E. P. Martin:

Detroit B. & I. Wks., J. E. Wickersham, Denver	$19,200
Pittsburg Bridge Co., Pittsburg, Pa.	21,250
Bullen Bridge Co., Pueblo, Colo.	21,500
Wrought Iron Bridge Co., Canton, O.	21,900
Colorado Iron Works, Denver, Colo.	20,000
The King Bridge Co., Cleveland, O.	21,650
Milwaukee Bridge & Iron Wks., Milwaukee	20,900
Lane B. & I. Wks., M. J. Patterson, Denver	21,175
Chicago B. & I. Co., Chicago	22,950
Youngstown Bridge Co., Youngstown, O.	16,000
Mo. Valley B. & I. Wks., Leavenworth, Kan.	21,176
Farnsworth & Blodgett, Kansas City, Mo.	22,000

COLUSA, CAL.—The supervisors of Colusa county have adopted plans for a pile bridge, 300 ft. in length, to be built over a cut on the east side of the Sacramento River, one-fourth of a mile south of the Colusa drawbridge. The spans of the bridge are designed to be 20 ft. wide and the roadway 20 ft. wide. Engr., C. P. Wilson, Colusa.

TACOMA, WASH.—The county commissioners received the following bids for the combination iron and wooden bridge at Orting: Tacoma Bridge & Construction Co., $2,600, $2,575, $2,700, $2,724, $2,810, $2,840, and $125 added for crib piers; Bullen Bridge Co., Portland, $3,889 and $3,800; L. Van den Steen, $3,399, $3,235, $3,148, $2,990, with $221 added for cribs.

MONTREAL, QUE.—The city surveyor has prepared plans for a new bridge over the Grand Trunk R. R. tracks at Mountain St. according to reports, the plans showing a bridge 720 feet in length, with cut stone piers at both ends of 100 ft. and 70 ft.

WATER-WORKS.

JOHNSON, VT.—At a village meeting Nov. 17 the trustees were instructed to procure a better water supply. Bonds for $10,000 will be issued for works and an electric light plant.

NEWPORT CENTER, VT.—The Newport Center Water Co. has been incorporated. The pipe is now being laid.

READSBORO, VT.—The village has been authorized to issue bonds to increase its water supply.

LENOX, MASS.—Chas. Brush, Engr., has estimated the cost of enlarging the reservoir at $10,500, and the cost of piping the proposed gravity supply at $22,000, making a total of $32,500.

SHEFFIELD, MASS.—Harry L. Andrews, W. H Dresser, W. H. Little and others have petitioned for a charter for the Sheffield Water Co., with authority to put in works.

WALPOLE, MASS.—It is reported that a town meeting will soon be held to elect three water commissioners.

WORCESTER, MASS.—S. M. Gray, Providence, has been engaged as consulting engineer to investigate the question of a new water supply to relieve the present scarcity.

BRISTOL, R. I.—Plans are being discussed for an artesian supply, according to reports.

BRANFORD, CONN.—The Branford Water, Light & Power Co. has been organized; Pres., F. W. Allderidge; Secy., E. F. Bennett; Treas., F. W. Giddings, all of New Britain.

WILLIMANTIC, CONN.—The special committee has recommended that a 750,000-gallon pumping engine be purchased.

BUFFALO, N. Y.—Bids are asked until Dec. 11 for removing rock for laying water pipe in Grider St. R. G. Parsons, Secy. Dept. Pub. Wks.

NEW YORK, N. Y.—The contract for laying a main from the new aqueduct to the pumping station at high bridge has been awarded to Domenico Lordi, at $10,920.

ROCKVILLE CENTER, N. Y.—An election was held Nov. 26 to vote on the question of works.

DUNMORE, PA.—The Dunmore Gas & Water Co. is building a 1,300,000-gallon reservoir to secure better fire protection.

NEWVILLE, PA.—The Newville Water Co. has been organized and has petitioned for a franchise.

WASHINGTON, D. C.—Bids are asked by the district commissioners until Dec. 10 for a supply of cast iron pipe.

NEWPORT NEWS, VA.—The Newport News Light & Water Co. is reported as to extend its service to Hampton and Old Point, at a cost of $100,000.

CLEVELAND, O.—Bids are asked until Dec. 10 for an independent air pump and jet condenser for the Division St. pumping station. J. H. Farley, Dir. Pub. Wks.

ANGOLA, IND.—Bids are asked until Dec. 6 for constructing works. Chas. V. Foulk, Clk., writes us that the supply will be from wells; population, 2,000; Engrs., Fort Wayne Engineering Co.

MENOMINEE, MICH.—The appraisers have valued the works at $75,000, according to reports, and the council is considering the purchase of the plant.

EDWARDSVILLE, ILL.—It is stated that the Edwardsville Water Co. has sold $50,000 of bonds to Frederick G. and Thomas Niedringhaus, of Edwardsville.

HENRY, ILL.—The local papers are agitating the question of works.

KNOXVILLE, ILL.—Efforts are being made to secure works, according to reports.

MAYWOOD, ILL.—Arthur Jones, Village Pres., writes us that works will be put in by special assessment on 5-year plan. Surveys are now being made; population, 3,000.

MILAN, ILL.—Geo. W. Smith, Clk., writes us that the contract for works has been awarded to Casgrain & McDonald, Chicago, at $11,355; supply from artesian well. Engr., W. A. Darling, Rock Island.

ROCK ISLAND, ILL.—Bids are asked until Dec. 3 for the construction of a stand-pipe and foundations. A. D. Huesing, Cy. Clk.

VANDALIA, ILL.—The City Water Co. has been incorporated at Chicago to build works; capital stock, $20,000; incorporators, Isaiah W. Newcomer, Fremont Hill and C. F. Higgins.

CLINTON, WIS.—The contract for constructing works has been awarded to Fairbanks, Morse & Co., Chicago. The village will issue $13,000 in 5% bonds.

EAU CLAIRE, WIS.—The council is taking steps to purchase the works.

WATERVILLE, MINN.—An election will be held Dec. 1 to vote on an issue of bonds for works.

GRAND ISLAND, NEB.—The council is reported as about to purchase a pumping engine.

BENTONVILLE, ARK.—It is reported that F. P. McMullen, Little Rock, will submit a proposition to the council for putting in works.

BRENHAM, TEX.—The council has voted to purchase the works for $40,000.

TRINITY, TEX.—The Trinity Water-Works Co. has been organized to put in works. An artificial lake will be built at once. Pres., Col. A. T. Anderson; Secy. and Treas., D. W. McLeod.

DENVER, COLO.—The Goldfield Water, Gas, Electric Light & Power Co. has been incorporated by Peter J. Frederick, Alois Koch and Jno. L. Frazer, of Denver; capital stock, $100,000. Goldfield is a town in El Paso county, being laid out by the Portland Town & Mineral Co.

FORT COLLINS, COLO.—Bids are asked until Dec. 17 for the purchase of $105,000 in 5% funding water bonds. C. E. Lull, Cy. Clk.

GRAND JUNCTION, COLO.—An election will be held Dec. 28 to vote on an issue of $250,000 in 5% bonds for new works; supply from mountain lake 26 miles distant; reservoir three miles from the city, at an elevation of 160 ft. S. G. McMullin, Cy. Clk.

ILWACO, WASH.—There is talk of issuing $20,000 in bonds for works.

SAN LUIS OBISPO, CAL.—C. F. Sammann, Cy. Clk., writes us that a committee has had two wells bored, securing a sufficient supply, and an engineer will soon be engaged to prepare plans and estimates for new works.

AYLMER, ONT.—E. J. Rainboth has transferred his franchise to construct works in this place to W. Poupore, of Poupore & Fraser, Morrisburg. The site for the pumping station has been purchased.

WINDSOR, ONT.—The water board has petitioned that an appropriation of $30,000 for a filter plant be voted on at the next election.

WINNIPEG, MAN.—An election will be held Dec. 18 to vote on an issue of $225,000 in 4% water bonds for new works and for an electric light plant.

ARTESIAN WELLS.

AUSTIN, TEX.—It is reported that two artesian wells will be bored to a depth of 1,400 to 1,900 ft. Address J. N. McAuther.

SAN MARCOS, TEX.—Bids are asked until Dec. 18 for boring an artesian well on the property of the U. S. fish commission near this city, as stated in our advertising columns. Address Marshall McDonald, U. S. Fish Comr., Washington, D. C.

IRRIGATION.

NEW YORK, N. Y.—The Anglo-American Irrigation Co., Ltd., has been incorporated in West Virginia to construct waterways and water supplies in the state of Zacatecas, Mexico; capital stock, $1,000,000; incorporators, Chas. L. Foxwell, New York; Fitzhugh Dibbell, Sea Cliff, Long Island, N. Y.; Stanley Gifford, New York; L. F. Keegan, New Brunswick, N. J.; L. Bayles, Brooklyn, N. Y.

EAST RIVERSIDE, CAL.—The East Riverside Irrigation District is reported as preparing to extend its pipe lines about three miles, at a cost of about $20,000. F. C. Finkle, Ch. Engr., is preparing the plans. The conduits are reported as of 24 to 15-in. sheet iron.

FRESNO, CAL.—Bids are asked until Dec. 10 for the construction of the complete works of the Sunset Irrigation District. J. N. King, Secy.

PHOENIX, ARIZ.—The Pennsylvania Irrigation Co., incorporated some time ago with a capital stock of $1,000,000, is reported about to begin work on the construction of a storage reservoir near this city. C. L. Hussey, Pittsburg, Pa., is said to be interested.

NEW COMPANIES.—Yakima Central Irrigation Co., Seattle, Wash.; $180,000; J. C. Henderson, I. A. Nadeau, T. H. Tyndale.

Gering Canal Co., Gering, Neb.; $600,000; Martin Gering, E. W. Sayre, A. B. Wood, Frank Beers, F. M. Sands, G. W. King.

Farmers' Union Irrigation Ditch Co. No. 1, Hutchinson, Neb.; $11,000; A. S. Kingery, J. Miller, O. W. Hutchinson, A. W. Kingery, L. O. Prouty.

Lillian Precinct Irrigating Ditch & Power Co., Lillian, Neb.; $45,000; H. P. Gates, L. H. Jewett, J. E. Ash, A. Wallace, David McGugin, Frank Doty.

Niobrara River Irrigation & Power Co., O'Neill, Neb.; $5,000,000; R. R. Dickson, A. U. Morris, A. J. Meals, J. McHugh, B. D. Sherwood, B. S. Gillespie, S. J. Weeks, O. O. Snyder.

SEWERS.

FARMINGTON, ME.—G. W. Wheeler, G. C. Purington and W. F. Belcher have been chosen a committee to investigate the question of improving the system.

EXETER, N. H.—McClintock & Woodfall, Boston, have been engaged to make plans for the better disposal of the sewage. The committee consists of J. W. Merrill, J. H. Brown and C. G. Gooch.

LOWELL, MASS.—The aldermen are discussing an ordinance for issuing $12,000 in bonds to construct a sewer in Thorndike St.

NEW YORK, N. Y.—Bids are asked by the commissioner of street improvements, 2622 Third Ave., until Dec. 5 for constructing sewers in two streets.——W. B. Parsons, Engr., has reported that to construct the proposed underground rapid transit system 24,935 ft. of new sewers would be required in Broadway, 12,930 ft. in side streets, and 5,760 ft. of new sewers in connection with Canal. Total, 43,625 ft.

TONAWANDA, N. Y.—Plans have been prepared by W. B. Landreth for sewers in Gastown. The land being too low for the gravity system, a sewage pumping station will be required. The system is estimated to cost, complete, $35,000, and from $2,000 to $5,000 a year to maintain. Martin Riesterer, A. C. Campbell, J. N. Pinner and E. W. Betts are members of the committee.

WHITE PLAINS, N. Y.—The trustees have adopted plans for sewers in Cromwell Place, Mamaroneck Ave. and Bank St.

PATERSON, N. J.—The aldermen have passed ordinances for constructing 7,450 ft. of 18 to 8-in. pipe sewers. George Boyd, Cy. Clk.

PERTH AMBOY, N. J.—Bids are asked until Dec. 10 for constructing a sewer in two streets. Malachi Graham, St. Com.

PITTSTON, PA.—Bids are asked until Dec. 20 for constructing 26,185 ft. of 30 to 8-in. pipe sewers and 3,720 ft. of 60 × 40-in. to 36-in. brick sewers in the borough of West Pittston, as stated in our advertising columns. H. J. Sanders, Secy.; Engrs., Potter & Folwell, Pittsburg and New York.

TUNKHANNOCK, PA.—Potter & Folwell, New York, and Pittsburg, have been engaged to prepare plans for a system.

CHARLESTON, S. C.—The Bailey-Lebby Co., 213 Meeting St., who were awarded the contract for constructing the proposed system in this city, as recently noted in these columns, is reported as receiving bids for the following materials: 400 carloads 18 to 8-in. sewer pipe; Y connections for each, with 6-in. opening (deep-socket pipe, the small sizes to have sockets not less than 2½ ins. deep); 1,000 tons of 4 and 6-in. standard cast iron water pipe; 400,000 lbs. castings, such as manhole covers and rings; 1,000,000 hard brick; about 100,000 ft. of lumber; 7,000 bbls. Rosendale cement; 700 to 800 siphons.

BELLEVUE, KY.—John Trapp has been awarded the contract for constructing sewers in Taylor Ave. and paving the avenue with Hallwood blocks, at $20,420.

HAMILTON, O.—Bids have been received from the following firms for constructing 11 miles of sewers, according to local papers: Hamilton Construction Co., W. R. Mercer & Son, A. F. Nims, Greenville Construction Co. Timothy McNerny, Leiter & Van Derveer, Hines & Ryan, Wm. White, Bartow & Clements, Wilson, Strack & Kinch, J. C. Cross, Walker & Robinson, W. H. Louthan, Wm. B. Boaz and Berry & Meehan. The lowest bid is reported as about $29,807, and the highest about $46,000; engineer's estimate, $49,037.

CRAWFORDSVILLE, IND.—The city engineer estimates the cost of constructing a system, now being discussed by the council, at 50 cts. per front ft.

FORT WAYNE, IND.—Bids are asked by the board of public works until Dec. 7 for constructing 18 to 12-in. pipe sewers in six streets.

CHICAGO, ILL.—Bids are asked until Dec. 3 for constructing private drains in 13 streets. H. J. Jones, Comr. Pub. Wks.

PEORIA, ILL.—Plans for the West Bluff sewer system to drain 1,100 acres, recently noted as in preparation, have been completed. It is stated that the work will be done next year.

TUCSON, ARIZ.—The construction of a system is being discussed.

TEXARKANA, ARK.—J. H. Haney and F. W. Gibb, Little Rock, have been awarded the contract to prepare plans and superintend the construction of sewers in district No. 1. It is reported that the plans will be ready by Dec. 15 and the system, which will cost about $20,000, is to be completed by June 1.

AUSTIN, TEX.—It is reported that about 6,000 ft. of 8-in. pipe sewers will soon be constructed. Engr., J. T. Smith.

STREETS.

NEW YORK, N. Y.—Bids are asked by the commissioner of street improvements, 2022 Third Ave., until Dec. 5 for grading and curbing in three streets.—M. T. Daly, Comr. Pub. Wks., has awarded the following contracts for paving: DeWitt C. Banker, $6,529; F. Thilman, Jr., $5,885 and $3,491; W. S. Smith, $6,223 and $21,512; Barber Asphalt Paving Co., $20,970 and $10,360.

HOMESTEAD, PA.—James McSpadden, Rockwood, Pa., has been awarded the contract by the Second Ave. Traction Co., of Pittsburg, for paving with irregular block stone the tracks of the above company between this place and Streets Run. The work was started Nov. 21.

McKEESPORT, PA.—Patton & Gibson, Pittsburg, were awarded the contract for grading, paving with brick, curbing and flagging of Cherry Lane, and the work was started Nov. 12.

FREDERICKSBURG, VA.—It is reported that the council will soon pave the streets.

LAUREL, MD.—F. T. English wants information as to the cheapest and best kind of a street for a town with a population of 3,000. This town has appropriated about $100,000 for street improvements.

CINCINNATI, O.—Bids are asked by the board of administration until Dec. 5 for paving a portion of Seventh St. with asphalt.

CLEVELAND, O.—The park and boulevard commissioners have received the following bids for constructing sections 3, 4 and 5 of the high level driveway along the Doan Brook gully:

	Secs. 3 and 4.	Section 5.	Secs. 3, 4 and 5.
Edward Conley	$38,580	.....	.....
Clement Bros	46,451	$18,012	$64,463
Campbell Bros	55,829	20,706	.....
F. H. Eggers	60,812	23,967	81,981
James Connelly	63,289	.....	.....
W. H. Ford & Co	68,051	25,936	93,184
A. W. Brannan	68,322	26,566	.....
F. P. Beers	68,416	25,928	.....
T. L. Fliedner	.....	16,848	.....
William Wacks	.....	16,884	.....
Spence Bros	.....	20,336	.....
John Moran	.....	21,581	.....
W. J. Gawne (awarded contract)	.....	.....	53,468
McCracken & Donwell	.....	.....	71,670
Neal Norton	.....	.....	78,179
Ferguson Contracting Co.	.....	.....	80,903
A. Tubman	.....	.....	82,135
Barbou & Ruple	.....	.....	89,339

MADISONVILLE, O.—Bids are asked until Dec. 24 for the purchase of $5,647 of street improvement bonds. Bennett Carter, Clk.

CHICAGO, ILL.—Bids are asked until Dec. 3 for improving portions of 15 streets. H. J. Jones, Comr. Pub. Wks.

EAST ST. LOUIS, ILL.—The council is reported to have received bids from the following persons for reconstructing over a mile of Eighth St.: Hill & O'Meara, Francis McCabe (reported the lowest), Casper Stolle, Fruin & Co., Skrainka & Co., Wade Bros., R. M. Quigley & Co., Steifel & Ruckert and Allen & Veiths. The cost of the construction of the southern part, from Broadway to St. Louis Ave., will be about $14.30 per front ft., and that of the remainder, from St. Louis Ave. to Exchange Ave., about $7.77 per front ft. The street will be filled in some places 20 ft., but in others a slight cut will have to be made. The paving will be of the finest Wabash vitrified brick, placed upon a base of gravel and sand. The total cost of the reconstruction will be about $109,000, which amount will be paid in five equal annual installments. Work on the street will commence about Dec. 1.

ST. LOUIS, MO.—The board of public improvements has been petitioned to improve portions of 54 streets. It is probable that about $40,000 will be appropriated to commence work at once on some of the more important streets.

OLYMPIA, WASH.—Press reports state that the citizens of this city have authorized the incurring of the necessary indebtedness for building a solid roadway across the bay to the west side, to replace the bridge. This will be filled in with the material now being dredged from the harbor under government contract.

SEATTLE, WASH.—The board of public works will soon be petitioned to pave a portion of Pike St. with brick, with granite curbing, estimated to cost about $18,000.

ELECTRIC LIGHT AND POWER.

JOHNSON, VT.—The village has voted to issue bonds for an electric light plant and water-works. B. L. Austin is town clerk.

ESSEX, CONN.—It is reported that a company may be organized to put in an electric light plant at this place.

SPRINGVILLE, N. Y.—The trustees have awarded the contract for furnishing an electric light plant for the village to the Western Electric Co., Chicago, Ill., at $9,790.

WEEDSPORT, N. Y.—W. J. Bell Pres. Weedsport Spring Wire Truss Co., writes us that the company has been granted a franchise for lighting the village with electricity and for furnishing motive power, and that maps have been sent to electric companies for bids and specifications for equipping the plant.

READING, PA.—Press reports state that the committee appointed to report upon the advisability of the city providing its own electric light plant has prepared a report covering 25 pages. The committee will urge the city to erect a plant to cost about $150,000, and will recommend the abolition of incandescent lights for street illumination, and that the present number of arc lights be doubled. The streets of Reading are at present lighted by the Metropolitan Electric Light Co., a corporation in which Philadelphians principally are interested. The annual cost to the city is nearly $50,000.

FAYETTEVILLE, N. C.—It is reported that the council is considering the question of lighting the streets by electricity. W. S. Cook, Mayor.

BROWNSVILLE, TENN.—J. R. Bond and J. A. Brewer have been granted a franchise for putting in an electric light plant.

BAYARD, O.—It is reported that estimates are being made for an electric light plant.

SPENCERVILLE, O.—An election will be held Dec. 27 to vote on the question of issuing $12,000 in bonds for an electric light plant.

FARIBAULT, MINN.—Press reports state that a new electric light and power company has been organized in this city. It will utilize the Polar Star mill water power to run its plant, and will furnish both light and power. There is some talk of an electric street railway to be run throughout this city and out to Cannon and Roberts' Lakes, three and four miles from the city.

MILWAUKEE, WIS.—The counil is considering the construction of a municipal electric light plant which the committee estimates will cost about $600,000, with a capacity of 1,000 lights.

CAPE GIRARDEAU, MO.—Press reports state that Gannon Bros. have purchased the Home Electric Light Plant of Hartsell & Son and will put in new machinery, consisting of a 1,000-light incandescent and a 50-light arc machine. They have a contract for lighting the city for 10 years with 22 arc lights, to be run by them in connection with the water-works plant, which will be in operation about January.

TORONTO, ONT.—The Georgian Bay Ship Canal & Power Aqueduct Co. is making a topographical map of a tract of country, two miles wide, between Lake Ontario and Lake Simcoe, contours ten feet apart. Wills Chipman is in charge of the surveys. For information respecting the projected work address J. A. Macdonald, Secy.

WINNIPEG, MAN.—An election will be held Dec. 18 to vote on an issue of $225,000 in bonds for an electric light plant and water-works.

NEW COMPANIES.—Union Electric Co., Halstead, Pa.; $10,000; Treas., T. H. Hayes.

Paragould Electric Light Co., Paragould, Ark.; $5,500; T. H. Wyse, D. A. Bertig.

Merchants' Electric Co., Marceline, Mo.; $6,000; G. W. Early, W. A. Carter, W. A. Cannon.

Montpelier Electric Light Co. Montpelier, Ind.; $15,000; J. P. McGeath, Hartford City.

American Gas Engine Electric Co., Chicago, Ill.; $250,000; F. M. Charlton, J. D. Rowe.

Raleigh Electric Co., Raleigh, N. C.; Pres., A. A. Thompson; Secy. and Treas., F. H. Briggs.

Luling Electric Light & Power Co., Luling, Tex.; $20,000; W. R. Johnson, W. W. Lipscomb, F. R. Starr, Jr.

Goldfield Water, Gas, Electric Light & Power Co., Denver, Colo.; $100,000; P. J. Frederick, Alois Koch, J. L. Frazer.

Shore Electric Co., Red Bank, N. J.; $100,000; F. W. Ward, East Orange; H. P. Chandler, Newark; Perry Ingalls, Verona.

Dynamo Electric Maintenance Co., Hoboken, N. J.; $500,000; G. F. Dunsmore, R. S. Ashe, Boston; Leon Abbett, Jr., Hoboken, N. J.

City Water Co. of Vandalia, Chicago, Ill.; $20,000; to build an electric light, heat and power plant; D. W. Newcomer, C. F. Higgins.

Traders' Annex Co., Clarksburg, W. Va.; $1,000,000; to build electric light plants and street railways; T. M. Jackson, D. R. Morgan, W. B. Maxwell.

GARBAGE DISPOSAL.

NEW HAVEN, CONN.—The board of health has petitioned for $10,000 for a new system of garbage collection and disposal.

READING, PA.—James Hangens, Secy. Bd. of Health, writes us that no definite action has been taken regarding garbage disposal, but that the board of health is investigating the subject before making a report to the council and asking for an appropriation for the work.

ST. PAUL, MINN.—The council has voted to advertise for bids for two 50-ton crematories, instead of for one 100-ton crematory. The crematories will be located on opposite sides of the city.

OAKLAND, CAL.—Press reports state that at the next meeting of the council the board of health will petition for the immediate erection of a garbage crematory, estimated to cost about $15,000.

MISCELLANEOUS CONTRACTS AND SUPPLIES.

DREDGING.—St. Augustine, Fla.—Bids are asked until Dec. 21 for dredging in Charlotte Harbor, Fla. Maj. Thos. H. Handbury, U. S. Engr. Office.

STATION.—Atlanta, Ga.—Press reports state that the Seaboard Air Line is about to construct a $50,000 passenger station in this city, for which the plans have been completed.

MARINE RAILWAY.—Brunswick, Ga.—It is reported that surveys are being made for a marine railway to be constructed by the Brunswick Foundry, Machine & Mfg. Co.

EMBANKMENT.—Cincinnati, O.—Bids are asked until Dec. 6 for furnishing earth and strengthening embankment at Shawneetown, Ill. Lieut.-Col. Amos Stickney, U. S. Engr. Office.

TUBULAR BOILERS.—Brooklyn, N. Y.—Bids are asked until Dec. 4 for four tubular boilers and four iron tanks for new school buildings. J. R. Thompson, Chn. Com., 131 Livingston St.

LUMBER AND STONE.—Sioux City, Ia.—Bids are asked until Dec. 17 for furnishing lumber, piling and broken stone to be delivered at Pierre, S. Dak. Capt. N. F. Hodges, U. S. Engr. Office.

ELEVATOR.—Duluth, Minn.—Bids are asked until Dec. 20 for a passenger elevator for the U. S. public building in this city. Address Chas. E. Kemper, Acting Supervising Architect, Treasury Department, Washington, D. C.

GAS PLANT.—Medford, Mass.—The Citizens' Gas Co. has been organized and is reported as preparing plans and estimates for the construction of a plant at the earliest possible date. The directors are F. D. Allen, H. E. Turner, C. J. Lee, J. A. Pierce and W. I. Cushing.

RETAINING WALL.—Pittsburg, Pa.—The Baltimore & Ohio R. R. Co. has awarded the contract for tearing down and rebuilding a large retaining wall on Second Ave., in Ward 16, of this city, to Patton & Gibson, Pittsburg. Work was begun Nov. 12, and is being pushed day and night to a rapid completion.

PIPE COVERINGS.—Washington, D. C.—Bids are asked until Dec. 11 for covering steam pipes in U. S. public buildings at Brooklyn, N. Y.; Bay City, Mich.; Denver, Colo.; Hoboken, N. J.; Kalamazoo, Mich.; Louisville, Ky.; New Bedford, Mass., and Rochester, N. Y. Chas. E. Kemper, Acting Supervising Arch., Treasury Dept.

RAILWAY STATION AND FERRY HOUSE.—The Staten Island Rapid Transit R. R. Co. will award in a few weeks the contract for a large new station at St. George, Staten Island, for the use of the Rapid Transit trains and the B. & O. R. R. main line trains. Address J. Frank Emmons, New York, president. The architects are Baldwin & Pennington, 44 South St., Baltimore, Md.

CONCRETE WALL, ETC.—Brooklyn, N. Y.—Bids will be received at the Navy Department, Washington, until Dec. 24, according to a press report, for $500,000 worth of work at the Brooklyn navy yard, including a new concrete quay-wall, 460 ft. long, at the foot of the main street, and one 316 ft. in length along Whitney Basin; a causeway 522 ft. long; boiler shop extension, a new plate-bending shop, 200 × 85 ft., etc.

CANAL WORK.—Ottawa, Ont.—Bids were opened Nov. 17 for constructing two sections of the Trent Canal; 5½ miles on the Sincoe and Balsam Lake division, and 3½ miles on the Peterboro and Lakefield division. The first section is reported as all excavation and a good part of it rock work. The contract for this has been awarded to Andrew Onderdonk, Chicago. The contract for the second section was awarded to Hogan & McDonald, Montreal. Press reports state that 15 bids were received and that the contract prices were in the neighborhood of $500,000 and $250,000, respectively for the two sections.

CONTRACT PRICES.

PIPE.—Bar Harbor, Me.—A contract for about 310 tons of 14 to 10-in. cast iron pipe has been awarded by the Bar Harbor Water Co. to the McNeal Pipe & Foundry Co., at $22.25 per ton of 2,240 lbs.

DREDGING.—San Francisco, Cal.—Maj. W. H. Heuer, U. S. Engineer Office, received the following bids Nov. 12 for dredging in Petaluma Creek, Cal.: Wil. S. Bliss, San Francisco, 14 2-7 cts. per cu. yd.; Pacific Coast Dredging & Reclamation Co., San Francisco, 17 cts.

SEWERS.—Portsmouth, Va.—W. T. Brooke, Cy. Engr., Norfolk, has sent us the following statements of the bids received Nov. 20 for constructing the proposed sewer system. The work was advertised in June and eight bids received, ranging from $46,151 to $151,529. The contract was awarded to the lowest bidders and the bids published in our issue of July 19 under Contract Prices. The price for pipe sewer is for terra cotta pipe laid complete:

Bids Received at Portmouth, Va., Nov. 20, 1894, for Constructing Sewers.

Bidder.	Pipe, 18-in. 5,830 ft.	Pipe, 12-in. 555ft.	Pipe, 10-in. 830 ft.	Pipe, 8-in. 7359ft.	Pipe, 4-in.,* 50000ft.	C.I.pipe, 18-in., 650ft.	Flush tanks, 124.	Inspctn pipe, 19.	Manholes, 190.	Total.
Sanford, Brooks & Bonsall, Norfolk, Va	$0.79	$0.60	$0.60	$0.40	$0.18	$3.25	$50.00	$15.00	$30.00	$55,740
T. E. Foley, Marshalltown, Ia	.95	.69	.65	.39	.19	4.00	60.00	17.00	27.00	57,967
Geo. O. Tenney, Chattanooga, Tenn	.83	.62	.57	.46	.18	2.96	47.60	18.00	29.60	59,902
John Jacoby, Wilmington, Del	1.09	.60	.50	.40	.20	4.00	75.00	10.00	30.00	61,919
Carter M. Braxton, Newport News, Va	1.85	1.50	1.45	.32	.25	6.00	60.00	33.00	30.00	64,107
J. E. Riley, Plattsburgh, N. Y	1.09	.70	.67	.44	.20	6.00	70.00	17.00	28.00	65,109
Maguire, McKnight & Co., Bound Brook, N. J	.92	.80	.72	.48	.19	3.10	70.00	15.00	29.00	65,369
Geo. Dole Wadley, Macon, Ga	.90	.80	.80	.52	.20	3.00	59.50	15.00	25.00	66,960
Jas. W. Wilding, Indianapolis, Ind	.85	.73	.65	.54	.20	3.00	50.00	12.50	28.00	67,078
Acock & Son, Trenton, N. J	1.28	.89	.71	.52	.18	3.20	55.00	12.50	30.00	68,220
Virginia Paving & Construct'n Co., Lynchburg, Va.	1.69	1.35	1.13	.57	.18	3.60	60.00	15.00	32.00	76,639
Owen Patterson, Baltimore, Md	1.25	.75	.68	.60	.20	4.00	60.00	30.00	40.00	77,392
B. J. Coyle, Washington, D. C	1.24	1.10	1.00	.87	.24	4.50	65.00	30.00	30.00	90,518
Graham & Riddle, Norfolk, Va	1.90	1.58	1.58	1.47	.16	3.30	70.00	12.10	40.00	144,857
Jos. McGlathery & David France, Philadelphia, Pa.	1.80	2.40	2.36	1.45	.22	3.20	87.00	14.00	27.00	147,567

* House connections.

HYDRANTS.—Washington, D. C.—The following bids were received Nov. 17 for 200 fire hydrants and 50 street hydrants, according to reports:

	Fire.	Street.
M. J. Drummond, New York	$30.60*	$12.50
A. H. Haig, Philadelphia	36.39**	14.68
Raymond & Campbell Mfg. Co., Middletown, Pa.	39.77	16.27
Zebulon E. Coffin, Neponset, Mass.	33.00	14.00
Camden Iron Works, Camden, N. J.	40.50	....
Jenkins & Lingle, Bellefonte, Pa.	52.50	....
Ludlow Valve Mfg. Co., Troy, N. Y.	....	12.00

*With auxiliary valves, $41; without auxiliary valves, $35. **With auxiliary valves, $41; without auxiliary valves, $31.90.

STONE.—Philadelphia, Pa.—The following bids were received by Maj. C. W. Raymond, Nov. 19 for furnishing and depositing stone in the gap at the Delaware Breakwater, Del.: David V. Mowell, New York, $2.07 per ton, for 4,500 tons stone for leveling upper

surface, etc.; $3.37 per ton, for 6,750 tons large stone to be placed in superstructure; total, $32,062; and $1.57 per cu. yd., for stone taken from breakwater or ice breaker to be placed in superstructure; Geo. W. Andrews, Biddeford, Me., $2.62; $2.62; $20,475; and $2.62; Enoch Townsend, Somers Point, N. J., $3.15; $3.45; $37,462; and $2.25; Brandywine Granite Co., Wilmington, Del., $3; $6.50; $57,375; and $4.95; Haines & Smith, Washington, D. C., $2.97; $3.93½; $39,926; and $3.87; Pigeon Hill Granite Co., Rockport, Mass., $5.69; $7.73; $77,782; and $9.

GRANITE BLOCKS.—Bangor, Me.—The following bids were received Nov. 17 for furnishing the city 100,000 granite paving blocks, the price being per square yard:

Hayward Pierce, Frankfort, Me.	$1.12
Frank Bradbury, West Franklin, Me.	1.34½
Cunningham Bros., Swanville, Me.	1.30
Dolton Granite Co., Norridgewock, Me.	1.14
James C. Harmon, Green's Landing, Me.	1.05
Mr. Bassett, Bluehill, Me.	1.35
Augusta Granite Co., Augusta, Me.	1.48
A. N. Anderson, Swanville, Me.	1.15
W. P. Baird, Prospect Ferry, Me.	1.25
F. B. Goodwin, Bangor, Me.	1.25
Gray & Marden, Swanville, Me.	1.45
Fernald Bros. & Higgins, Mt. Desert, Me.	1.35
H. M. Thayer, Bangor, Me.	1.10
E. L. Warren, Prospect Ferry, Me.	1.07
Benj. V. Buckminster, Green's Landing, Me.	1.00
E. Noyes, East Sullivan, Me.	1.25
M. J. Coyne, Bangor, Me.	1.26½
David Brown, Bangor, Me.	1.15
James S. Cordon, Brooksville, Me.	1.19

WATER-WORKS.—Cascade, Ia.—M. Tschirgi, Jr., Engr., Dubuque, writes us that the following bids were received Nov. 18 for constructing the proposed water-works, as advertised in Engineering News: Fairbanks, Morse & Co., $12,190 for works complete; Stillwell-Bierce & Smith-Vaile Co., $1,013.20 for boiler and $1,005 for pump; Chicago Bridge & Iron Co., $2,864 for tower and tank; National Tube Wks, $17.25 for 8-in. valves, and $11.70 for 6-in. valves; and the following detailed bids:

	Pipe, ton.	Boiler.	Pump.
Dubuque Construction Co.	$22	$1,175	$1,375
Crellin & Lovell	26	1,300	992
Challenge Wind Mill Co.	22	908	950
S. Pope Co.	22	1,200	900

FILLING.—Boston, Mass.—The "Herald" states that the following bids were received Nov. 21 for furnishing 75,000 cu. yds. of filling on Roylston St., between Boylston road and Brookline Ave.; John O'Brien, 62½ cts. per cu. yd.; Neil McBride, 77 cts.; William Scollans, 74½ cts. At a previous opening of bids for this work Mr. McBride bid 85 cts.; Mr. O'Brien, 65 cts., and Mr. Scollan, 74½ cts. The same class of work that has been done in that neighborhood on Commonwealth Ave. was figured at 41 cts. per cu. yd.

WATER SUPPLY.—Johnstown, N. Y.—The total bids received Nov. 19 for an additional water supply were published last week under Water-Works. The contract is reported to have been awarded to the lowest bidder. The itemized bids were as follows; Supt., J. J. Buchanan; Engr., Geo. Yost:

Bids Received at Johnstown, N. Y., Nov. 19, for an Additional Water Supply.

Items.	John Marsden, Utica, N. Y.	G. D. Grannis, Syracuse, N.Y.	E. Bartl & Coon, Scranton, Pa.	Seymour & Banker, Glenorville, N.Y.	M. B. Birdseye, Fayetteville, N. Y.	Smith Bros., Pelhamville, N.Y.	P. H. Harrison & Son, Newark, N. J.	Beckwith & Quackenbush, Herkimer, N.Y.	Pidgeon Bros, Albany, N. Y.	S. E. Furgeson, Gloversville, N. Y.	Troy Pub. Wks., Troy, N. Y.	Hendricks, Taylor & Warren, Massachusetts.
16-in. pipe, 1,960 tons	$19.90	$21.00	$20.75	$20.00	$20.50	$20.00	$20.50	$21.50	$20.00	$20.50	$23.40	$19.75
Laying, 30,400 ft.	.32	.270	.41	.45	.38	.35	.395	1.77*	.47	.45	.48	.74
24-in. pipe, 13.5 tons	19.90	21.25	20.75	20.00	20.50	20.60	20.50	21.50	20.60	20.50	23.40	19.75
Laying, 144 ft.	.40	.30	.60	.80	.80	.65	.50	2.52	.60	2.00	.75	.74
8-in. pipe, 6 tons	19.90	21.25	20.75	20.00	20.50	20.60	20.50	21.50	20.60	20.00	20.40	19.75
Laying, 300 ft.	.22	.10	.24	.35	.25	.20	.20	.67	.40	.45	.25	.30
2-in. air valves, 12	5.00	9.00	7.00	4.05	8.00	8.00	19.25	8.00	9.00	7.00	5.00	4.00
16-in. gates, with box, 9.	63.00	72.50	75.00	61.25	58.00	58.00	61.25	72.50	69.00	65.00	63.00	60.00
8-in. gates, with box, 6.	21.00	25.00	21.00	21.00	20.50	20.50	20.00	21.80	24.00	25.00	20.50	19.00
24-in. gate, 1	155.00	185.00	....	....	....	....	170.00	....	....	....	185.00	....
Spec. cast'gs, 20,000 lbs.	.0225	.0275	.03	.0225	.025	.0225	.025	.03	.0225	.04	.0225	.025
Rock excav., 2,128cu.yds.	1.00	.98	.60	1.40	1.40	1.75	2.00	1.75	1.70	3.00	2.50	4.00
Core w'll excav.,200cu.yds	.30	1.00	.20	.60	.75	.30	.25	.40	.35	.50	1.00	.50
Embk..dam, 2,600 cu.yds	.30	.35	.24	.15	.35	.32	.50	.33	.33	.50	.40	.30
Excav., muck,2,000 cu.yds	.25	.13	.19	.30	.30	.25	.25	.40	.50	.50	.40	.50
Clear'g & grub'g, 9.5 acre	40.00	50.00	20.00	25.00	200.00	75.00	50.00	30.00	60.00	30.00	20.00	50.00
Mas., core w'll,300cu.yds	4.00	3.75	2.25	3.00	3.00	4.25	3.00	5.00	2.50	6.00	5.00	5.00
Mud pipe, 300 cu. yds.	3.50	3.75	2.00	3.00	3.25	5.50	3.00	4.00	3.00	6.00	5.00	5.00
Gate house, 160 cu. yds.	4.00	5.75	3.00	4.50	4.50	5.50	4.00	6.00	7.00	6.00	5.00	5.00
Concrete, 100 cu. yds.	3.00	4.50	3.50	4.50	5.00	4.20	4.50	7.00	4.50	7.00	5.00	5.00
Retaining wall,75 cu.yds.	2.00	2.00	1.00	2.00	1.50	3.00	2.00	2.50	2.25	1.25	3.25	2.50
Paving, 1,070 sq. yds.	.25	.60	.60	.55	.60	.50	1.00	.75	1.00	1.25	1.00	1.25
Puddle, 325 cu. yds.	.60	1.00	1.25	1.10	1.00	1.25	1.00	1.00	1.00	2.00	1.00	.90
Iron grate o'vr m'd pipe,1	5.00	12.00	....	....	....	....	....	12.00	....	....	....	....
Wire screens, 4	25.00	50.00	40.00	22.00	30.00	40.00	20.00	35.00	15.00	20.00	15.00	15.00
Wheel gears, 2	15.00	20.00	....	12.00	7.50	20.00	20.00	18.00	18.00	5.00	7.00	10.00
Gate house and bridge	200.00	350.00	....	....	....	....	....	....	....	....	....	....
Steamer hydrant, 1	30.00	35.00	....	....	....	....	....	....	....	40.00	....	....
Coping, 288 sq. ft.	.40	.50	1.25	.30	.35	.60	.60	.40	.40	.50	.35	1.25
Extra earth excavation	.40	.50	.43	2.50	.60	.30	.50	.50	.50	.50	.50	.50
Total	$58,381	$60,553	$61,888	$63,555	$63,839	$64,025	$64,626	$67,483	$67,511	$73,707	$73,763	$80,333

* Price on laying includes iron.

GASOLINE LIGHTING.—St. Paul, Minn.—The following bids were received Nov. 22 for lighting 3,000 to 3,500 gasoline street lamps for the ensuing year. The specifications provided as follows: (1) that the contractor shall furnish the necessary gasoline to sustain light equal to 16 c. p. in each street lamp from sunset until dawn of each night during the term of his contract, including the lighting of all lamps, keeping them in good repair, keeping the glass clean and bright, supplying the necessary burners, appliances and fixtures and other attachments, the burners to remain the property of the contractor at the expiration of his contract with the city; (2) same as preceding, the city to supply the burners; (3) same as preceding, except that the contractor is directed to furnish the gasoline burners and sell them to the city; (4) the contractor to furnish the burners and at the expiration of his contract they are to remain his property, he to be allowed rent for the same; (5) the contractor to furnish 1,500 street lamps, more or less, not attached to posts, of as good and substantial quality and appearance as those now in use; (6) price for furnishing of 750 cedar lamp posts, 10 ft. long; (7) price for removing the lamps from one point to another as the council may provide; (8) sheet iron street lamp signs, and (9) tin street lamp signs:

Bids Received at St. Paul, Minn., for Gasoline Lighting.

	1.	2.	3.	4.	5.	6.	7.	8.	9.
Wagner & Jay	$1.18½	$1.13½	$0.50	$0.05	$3.50	$0.60	$0.00	$0.05	$0.05
P. D. Scannell	1.07	1.05	1.35	0.05½	2.45	0.65	0.35	0.14	0.10
Isaac A. Grant	1.25	1.23	1.40	0.07	2.85	0.85	0.00	0.15	0.16
Robert Seeger	0.83	1.12	1.50	0.08½	2.31	0.60	0.00	0.15	....
*Acme Vapor Stove Co.	1.00½	1.01	1.50	0.05	2.35	0.55	0.00	0.13	0.14

*Present contractors.

REVETTING BANKS.—Charleston, S. C.—Capt. F. V. Abbott, U. S. Engineer Office, informs us that the following bids were received Nov. 14 for revetting banks of Wappo Cut, as advertised in Engineering News; (1) being price per cubic yard for 1,000 cu. yds. method A, and (2) for 1,500 cu. yds. method B:

	1.	2.	Total.
C. P. Huffman	$3.34	$3.29	$8,275
J. H. Hathaway & Co.	2.30	2.30	5,750
H. S. Cordes	3.15	3.10	7,800
Geo. Egan & J. Friday	3.05	2.90	7,400
D. V. Howell	3.07	2.87	7,375

SEWER BRICK.—Seattle, Wash.—The city has contracted with the Puget Sound Brick, Tile & Terra Cotta Co. for 25,000 vitrified, end-cut brick to be used in the 12th St. sewer, at $5.50 per M. brick, according to local papers, the usual price for such brick being $10.

CONDENSED LIST OF CONTRACTS PENDING WITH DATE OF OPENING BIDS.

Bids to be opened.	Work.	Place.	See Eng. News.
Nov. 30.	Interior bldg. work at	St. Albans, Vt.	Nov. 8
	Advertised, Eng. News, Nov. 8 and 15.		
Nov. 30.	Machine tools,	Watertown Arsenal, Mass.	Nov. 15
Nov. 30.	Channel work,	Richmond, Va.	Nov. 15
Nov. 30.	Pipe sewers,	Newark, N. J.	Nov. 22
Nov. 30.	Ry. ties, fencing, etc.,	Yarmouth, N. S.	Nov. 22
Dec. 1.	Electric lighting,	Ann Arbor, Mich.	Oct. 11
Dec. 1.	Sewer,	Rochester, N. Y.	Nov. 22
Dec. 1.	Brick paving,	Massillon, O.	Nov. 22
Dec. 3.	Pier,	Ottawa, Ont.	Nov. 8
Dec. 3.	Sidewalks,	Sioux City, S. Dak.	Nov. 15
Dec. 3.	Bridge,	Rome, N. Y.	Nov. 22
Dec. 3.	Sewers,	Ashtabula, O.	Nov. 22
Dec. 3.	Water bonds,	Cadiz, O.	Nov. 22
Dec. 3.	Water-wks. materials,	Newton, N. J.	Nov. 8
	Advertised, Eng. News, Nov. 8 and 15.		
Dec. 3.	Railway (10½ miles),	Moncton, N. B.	Nov. 22
Dec. 3.	Stand-pipe,	Rock Island, Ill.	Nov. 29
Dec. 3.	Street improvements,	Chicago, Ill.	Nov. 29
Dec. 3.	Bridge,	Meridian, Miss.	Nov. 29
Dec. 3.	Private drains (13 contracts),	Chicago.	Nov. 29
Dec. 4.	Grading, etc.,	New York, N. Y.	Nov. 22
Dec. 4.	Boiler house,	Philipsburg, Pa.	Nov. 22
Dec. 4.	Engine houses (3),	St. Louis, Mo.	Nov. 22
Dec. 4.	Tubular boilers,	Brooklyn, N. Y.	Nov. 29
Dec. 5.	Bridge,	Baltimore, Md.	Nov. 22
Dec. 5.	Bridge,	Montreal, Que.	Nov. 22
Dec. 5.	Water-wks. system,	Oswego, Ill.	Nov. 22
Dec. 5.	Stone,	Nashville, Tenn.	Nov. 22
Dec. 5.	Asphalt paving,	Cincinnati, O.	Nov. 29
Dec. 5.	Grading, etc.,	New York, N. Y.	Nov. 29
Dec. 5.	Sewers,	New York, N. Y.	Nov. 29
Dec. 6.	Street imp'v't bonds,	St. Bernard, O.	Nov. 15
Dec. 6.	Bridge superstructure,	Scranton, Pa.	Nov. 22
Dec. 6.	Water-works system,	Angola, Ind.	Nov. 29
Dec. 6.	Embankment,	Cincinnati, O.	Nov. 29
Jan. 7.	Water bonds,	Detroit, Mich.	Nov. 15
Dec. 7.	Water bonds,	New Bedford, Mass.	Nov. 22
Dec. 7.	Safety gates,	Brooklyn, N. Y.	Nov. 22
	Advertised, Eng. News, Nov. 22.		
Dec. 7.	Pipe sewers,	Fort Wayne, Ind.	Nov. 29
Dec. 8.	Water bonds ($4,000),	Rushford, Minn.	Nov. 22
Dec. 10.	Breakwater extension,	Buffalo, N. Y.	Nov. 8
	Advertised, Eng. News, Nov. 8 to 29.		
Dec. 10.	Water bonds ($100,000),	Steubenville, O.	Nov. 15
Dec. 10.	Electric lighting,	Millville, N. J.	Nov. 15
	Advertised, Eng. News, Nov. 15 and 22.		
Dec. 10.	Water bonds ($6,110),	Montevideo, Minn.	Nov. 22
Dec. 10.	Removing wreck,	Wilmington, Del.	Nov. 22
Dec. 10.	Bridge superstructure,	Warren, O.	Nov. 22
Dec. 10.	Pier work,	Duluth, Minn.	Nov. 22
Dec. 10.	Irrigation works,	Fresno, Cal.	Nov. 29
Dec. 10.	Air-pump and jet condenser,	Cleveland, O.	Nov. 29
Dec. 10.	Cast iron pipe,	Washington, D. C.	Nov. 29
	Advertised, Eng. News, Nov. 29.		
Dec. 10.	Sewer,	Perth Amboy, N. J.	Nov. 29
Dec. 11.	Island protection,	Richmond, Va.	Nov. 22
	Advertised, Eng. News, Nov. 22 and 29.		
Dec. 11.	Covering steam pipes,	Washington, D. C.	Nov. 29
	Advertised, Eng. News, Nov. 29 to Dec. 13.		
Dec. 11.	Rock excav. for water pipe,	Buffalo, N. Y.	Nov. 29
Dec. 12.	Electric lights,	Cleveland, O.	Nov. 22
Dec. 12.	Street cleaning,	Cleveland, O.	Nov. 22
Dec. 12.	Oil lamps (4,377),	Cleveland, O.	Nov. 22
Dec. 13.	Water-wks. system,	Morris, N. Y.	Nov. 22
	Advertised, Eng. News, Nov. 22 to Dec. 6.		
Dec. 13.	Bridge superstructure,	Scranton, Pa.	Nov. 22
Dec. 13.	Dike,	Philadelphia, Pa.	Nov. 22
Dec. 14.	Tunnel,	Cleveland, O.	Nov. 22
Dec. 15.	Surveying,	Flemington, N. J.	Nov. 22
	Advertised, Eng. News, Nov. 22.		
Dec. 17.	Wooden bridge,	Franklin, Neb.	Nov. 8
Dec. 17.	Lumber and stone,	Sioux City, Ia.	Nov. 29
Dec. 17.	Water bonds	Fort Collins, Colo.	Nov. 20
Dec. 18.	Telephone system,	Washington, D. C.	Nov. 22
Dec. 18.	Artesian well near	San Marcos, Tex.	Nov. 29
	Advertised, Eng. News, Nov. 29 to Dec. 13.		
Dec. 18.	Constructing water-wks.,	Newton, N. J.	Nov. 8
	Advertised, Eng. News, Nov. 8 and 15.		
Dec. 20.	Brick sewers,	San Antonio, Tex.	Nov. 22
	Advertised, Eng. News, Nov. 22 to Dec. 13.		
Dec. 20.	Pipe sewers,	San Antonio, Tex.	Nov. 22
	Advertised, Eng. News, Nov. 22 to Dec. 13.		
Dec. 20.	Sewer pipe, brick, etc.,	San Antonio, Tex.	Nov. 22
	Advertised, Eng. News, Nov. 22 to Dec. 13.		
Dec. 20.	Pipe sewers (26,185 ft.),	Pittston, Pa.	Nov. 29
	Advertised, Eng. News, Nov. 29 to Dec. 13.		
Dec. 20.	Elevator at	Duluth, Minn.	Nov. 29
Dec. 20.	Brick sewers (3,720 ft.),	Pittston, Pa.	Nov. 29
	Advertised, Eng. News, Nov. 29 to Dec. 13.		
Dec. 21.	Dredging,	St. Augustine, Fla.	Nov. 29
Dec. 24.	Street imp'v't bonds,	Madisonville, O.	Nov. 29
Dec. 24.	Concrete wall, etc.,	Brooklyn navy yard.	Nov. 29
Dec. 26.	Electric lighting,	Monroe, Mich.	Nov. 15

METAL MARKET PRICES.

LEAD.—New York: 3.12 to 3.15 cts. Chicago: 2.97 cts. St. Louis: 2.95 to 3.12 cts.

NAILS.—Pittsburg: 95 cts. for wire, and 85 cts. for cut at mill, in carload lots.

BARBED WIRE.—Pittsburg: galvanized, $1.9 to $2; plain, $1.2 to $1.25 for carloads at mill.

FOUNDRY AND PIG IRON.—New York: $10 to $13. Pittsburg: $10.75 to $11.75. Chicago: $9.50 to $10.50.

TRACK MATERIAL.—New York: angle bars, 1.25 to 1.4 cts.; spikes, 1.4 to 1.6 cts.; track bolts, 2 to 2.1 cts. with square, and 2.15 to 2.3 cts. with hexagon nuts. Chicago: angle bars, 1.3 to 1.35 cts.; spikes, 1.6 to 1.7 cts.; track bolts, 1.9 to 2 cts., with hexagon nuts.

RAILS.—New York: $24 at eastern mills and at tidewater; old rails, $11 to $12 for iron and $9 to $10 for steel; steel rails, fit for relaying, $16 to $19; light rails, $22 to $24; girder rails, $24. Pittsburg: $24 to $25 for standard sections; old rails, $12 to $12.50 for iron and $10 for steel. Chicago: $25 to $27; old rails, $10.75 to $11.25 for iron and $7 to $9 for steel.

STRUCTURAL MATERIAL.—New York: beams, 1.3 to 1.5 cts.; channels, 1.35 to 1.5 cts.; angles, 1.25 to 1.35 cts.; tees, 1.4 to 1.6 cts.; universal mill plates, 1.25 to 1.35 cts.; steel plates, 1.25 to 1.4 cts. for tank, 1.4 to 1.5 cts. for shell, 1.6 to 1.65 cts. for flange, 1.75 to 2 cts. for ordinary firebox, 2 to 2.25 cts. for locomotive firebox. Pittsburg: beams, 1.2 to 1.3 cts.; channels, 1.2 to 1.3 cts.; angles, 1.15 to 1.2 cts.; tees, 1.35 to 1.4 cts.; universal mill plates, 1.15 to 1.2 cts.; steel plates, 1.15 to 1.25 cts. for tank, 1.3 to 1.35 cts. for shell, 1.35 to 1.4 cts. for flange, 2.5 to 3.75 for ordinary firebox, and 3.35 to 3.5 cts. for locomotive firebox. Chicago: beams, 1.5 cts.; channels, 1.5 cts.; angles, 1.4 to 1.45 cts.; tees, 1.65 cts.; universal plates, 1.4 to 1.45 cts.; steel plates, 1.4 to 1.5 cts. for tank, 1.65 to 2.1 cts. for flange, 1.65 to 5 cts. for firebox.

INDUSTRIAL NOTES.

THE HAZARD WIRE ROPE WORKS, of Wilkesbarre, Pa., have shipped to the Metropolitan St. Ry., of St. Louis, a wire rope 32,300 ft. long and 1 5-16 in. diameter, weighing 102,200 lbs.

THE INDUSTRIAL WORKS, of Bay City, Mich., have a contract for four 30-ton cranes, and one 10-ton locomotive crane for the new works of the National Foundry & Pipe Works Co., at Scottdale, Pa.

THE COFRODE & SAYLOR BRIDGE WORKS, Pottstown, Pa., are expected to be out of the receiver's hands by January, as the creditors and stockholders have assented to the plans of reorganization.

WM. WHARTON, JR., & CO., Philadelphia, Pa., manufacturers of street railway track material, are erecting a new machine shop, 41 × 240 ft.; rail and fitting shop, 41 × 112 ft.; foundry, 50 × 214 ft., and a new power house.

THE GISHOLT MACHINE CO., of Madison, Wis., has added a number of machine tools to its equipment, including ten of its own standard turret lathes. It has recently shipped three of its machine tools to Vienna, one to St. Petersburg and four to Berlin.

THE SHEFFLER BRIDGE CO., of Pittsburg, Pa., has a contract for the iron buildings of the National Foundry & Pipe Works Co.'s plant at Scottdale, Pa. These will include a foundry 80 × 301 ft.; pipe cleaning shed, 30 × 301 ft., and a cupola house 26 × 35 ft.

THE PACIFIC FLUSH TANK CO., 57 Market St., Chicago, has been awarded contracts for furnishing its flush tanks for the new sewer work at Charlottesville, Va., Athens, Wooster and Hamilton, O., Connersville and South Bend, Ind., and at Madison, Wis. Pres., Sidney W. Milton.

THE KELLOGG IRON & STEEL CO., of Buffalo, N. Y., has been incorporated, with a capital stock of $5,000, and will manufacture iron trusses, etc., for bridges and buildings. Thomas H. Brooks, of Cleveland, O., and Charles H. Kellogg and Peter C. Newkirk, of Buffalo, N. Y., are the incorporators.

THE CONSOLIDATED CAR-HEATING CO., of Albany, N. Y., reports that 1,103 of its electric heating equipments for street cars have been sold since Aug. 1. The West End Ry. Co., of Boston; People's Traction Co., of Philadelphia; Nassau Ry. Co., of Brooklyn, and Buffalo Ry. Co., of Buffalo, have recently ordered over 700 car equipments.

FRASER & CHALMERS, of Chicago, Ill., have opened a supply department in connection with their general machinery business, and are prepared to furnish pipe, valves and fittings, candles, oils, picks, shovels, hose, packings and other supplies used in mill and mine work. The firm is ready to bid for such supplies in any part of the country, in large or small quantities.

CAR WORKS.—The new car shops at Dunkirk, Ind., now under construction, are principally one-story brick buildings, and include a boiler and forge shop, 70 × 83 ft.; power house 26 × 47 ft.; wood mill, 60 × 169 ft.; paint and oil store house, 28 × 38 ft.; paint shop, 83 × 90 ft.; passenger car repair shop, 83 × 154 ft.; storeroom, 19 × 46 ft.; machine shop, 83 × 199 ft.; office, 16 × 37 ft.

THE AUTO-PNEUMATIC RAILWAY SIGNAL CO., of Rochester, N. Y., has a contract from the Delaware, Lackawanna & Western R. R. and the Western New York & Pennsylvania R. R. to build one of its interlocking plants at the junction of these roads at Mount Morris, Pa. The plant put in by this company at the crossing of these two roads in Buffalo, N. Y., has a record of 150,000 operations without a failure during the past year, as noted in our issue of Nov. 1.

THE PHILADELPHIA ENGINEERING WORKS, of Philadelphia, Pa., have contracts from the Carnegie Gas Co., Pittsburg, for three 30 × 60-in. gas compressors, each driven by a 32 × 60-in. Philadelphia Corliss engine. They have also a contract from the Pittsburg Natural Gas Co., Pittsburg, for a pair of 30 × 60-in. gas compressors, each driven by a 24 × 60-in. Philadelphia Corliss engine, and have built for the Chamberlain Coal Co., of Poltsville, Pa., two 32 × 60-in. Philadelphia Corliss holding engines complete with drums, brakes, etc.

THE PENN BRIDGE CO., of Beaver Falls, Pa., reports orders coming in well for the season of the year, and has the following contracts on hands for iron buildings and roofs: Addition to rolling mill building of the Pittsburg Reduction Co., New Kensington, Pa., 70 × 35 ft.; addition to mill building of Ohio Steel Co., Youngstown, O.; addition to the tin-plate plant of New Castle Steel & Tin-Plate Co., of New Castle, Pa.; roof trusses of building 100 × 60 ft., of Niagara Falls Brewing Co., Niagara Falls, N. Y.; roof trusses for two pump houses of U. S. Government, Louisville, Ky.; roof for boiler house, West Virginia Central & Pittsburg Ry., Cumberland, Md.; roof for power house of Beaver Falls Electric Light & Power Co.; steel beams and columns for new works of Carborundum Co., Niagara Falls, N. Y. It has commenced the erection of a new steel mill, 60 × 280 ft., for the Union Iron & Steel Co., of Youngstown, O., and is also erecting roof trusses for the transforming room of the Cataract Construction Co., of Niagara Falls, N. Y., the room being 40 × 90 ft. It has also recently completed a steel building, 75 × 190 ft., for the Washington Carbon Co., at Washington, Pa., and also roof trusses for boiler house at the U. S. Navy Yard, Annapolis, Md.

NEW COMPANIES.—Mount Pleasant Brick & Quarry Co., St. Louis, Mo.; $40,000; Conrad Kempf and John Hoge.

Tacoma Traction Co., Tacoma, Wash.; $500,000; Stuart Rice and George B. Blanchard.

J. D. Shields Co., Elmwood City, Pa.; $1,000; firebrick and terra cotta; Treas., J. N. McBride.

Davies Car Wheel & Machine Co., Chicago, Ill.; $150,000; C. E. Gaylord, J. H. Lee and M. J. Frost.

International Filter Co., Chicago, Ill.; $30,000; Bernhard Engle, Simon Kamberg and W. A. Schoenfeld.

Buckeye Malleable Iron & Coupler Co., Columbus, O.; $500,000; W. F. Goodspeed, J. G. Deshler and Orland Smith.

Northern Construction Co., Tacoma, Wash.; $60,000; bridges and buildings, etc.; Fred. M. Gribble and G. O. Hickox.

Dickerman Emery Wheel & Machine Co., Bridgeport, Conn.; $40,000; George H. Strickland and Samuel S. Hunter.

Pennsylvania Enameled Brick Co., Oaks, Pa.; $100,000, commencing with $10,000; Treas., W. F. Burden, Newport, R. I.

Hyde Park Iron & Steel Co., Hyde Park, Pa.; $100,000, commencing with $10,000; Treas., F. S. Irwin, Leechburg, Pa.

Economy Water Tube Boiler Co., Jersey City, N. J.; $100,000, all paid in; Godfrey Engel, Baltimore, Md.; A. B. Krause, Jersey City.

Whippany Brick & Clay Mfg. Co., Plainfield, N. J.; $75,000, with $1,200 paid in; F. A. Dunham, Plainfield; B. I. Fallen, Summit, N. J.

Old Mexico Land & Improvement Co., Kansas City, Mo.; $25,000, with $12,500 paid in; Robert M. Snyder, W. G. Melville and Louis Kung.

International Power Storage Co., Albany, N. Y.; $5,000,000, with $250,000 paid in; utilizing superheated water as a motive power; H. W. Webb, Edgar Van Etten and A. G. Leonard, all of New York.

MUNICIPAL BOND MARKET.

New York, Nov. 26, 1894.

Just how much idle money there is seeking good investment has been well illustrated by the tremendous over-subscription for the new Government bond issue; over $150,000,000 was offered for the $50,000,000 issue. That the issue is three times over-subscribed evidences that not enough investors will succeed in placing their money in this security to materially affect the demand for the high-grade municipal issues. What is more to the point, the bulk of the offers for the new Government bonds came from institutions, as they alone are in a position to bid in the bonds in sufficient amounts to allow of their offers being accepted, and, while it is true that institutions have latterly been an important factor in the municipal bond market, still these securities always find their readiest market among individual investors, so that the demand from them continues as brisk as ever. It is argued by some that after the awarding of the Government bonds, municipal issues will be cheaper, for the reason that investors will turn their attention to the new 5s. When the dealers' profit, however, is added to the price at which the Government bonds were awarded, the net return to the would-be retail buyer would be only about 2¼ per cent., and as prime municipal issues can be bought at prices to yield the investor over 3½ per cent., the small buyer, who needs the income on his investments to live on, will not find much attraction in the Government issues.

It is easy to furnish illustrations of the eagerness with which dealers are picking up new issues. Milwaukee, Wis., sold $35,000 5-per cent. 1 to 20-year school bonds to Farsen, Leach & Co.; there were 20 other bidders, and the bonds brought 111.70, the highest price ever received by Milwaukee for its bonds. A $12,500 Northampton, Mass., 4-per cent. note, due July, 1902, was sold for 102.79, there being over a dozen bidders for this small sum. Stamford, Conn., obtained 105.053 for $25,000 4-per cent. 20-year sewer redemption bonds. In the same way Syracuse, N. Y., placed $350,000 on a 2¼-per cent. annual rate. The $50,000 Monson, Mass., 4-per cent. water bonds were awarded on a 3⅝ interest basis, there being 10 bidders.

Among other awards of municipal bonds recently made are the following: To N. W. Harris & Co., $150,000 Brooklyn, N. Y., 4% 19-year water loan bonds, at 107.83, and $50,000 Brooklyn, N. Y., 4% 20-year Soldiers' and Sailors' Monument bonds, at 110.81. There were 23 other bidders. To Benwell & Everett, New York, $100,000 Brooklyn, N. Y., 4% 3-year sewerage bonds, at 101.53. To E. H. Rollins & Sons, $50,000 Lincoln, Neb., 5% 10 to 20-year school bonds; $40,000 Mt. Vernon, N. Y., 5% 3-year tax relief bonds; $47,000 Paterson, N. J., 4½% 10-year sewer bonds, at 104.379, and $36,000 15-year 4½% bonds, at 106.199; $75,000 Pueblo, Colo., 5% school bonds. To Farsen, Leach & Co., $43,000 Olean, N. Y., 5% 1 to 10-year improvement bonds, at a premium of $50 for the lot.

From these instances it will be noted that the municipal bond market is as active as ever. What is more, prices show no indication of shading off. Brokers in general are agreed that, as long as current cheap money rates last, the present state of affairs will continue; and, as money is plentiful enough to assure low rates for some time to come, good prices for municipal bonds are assured for the near future.

MUNICIPAL BONDS.

	Price.
City of Boston Park Loan Reg. 5s, 1914	111¾
City of Boston Park Loan Reg. 4s, 1924	115
City of St. Louis, Mo., Refunding, 4s, 1912	10[illegible]
" " " " " 4s, 1918	108
Asbury Park, N. J., School 5s	106⅝
City of Tacoma, Wash., Water 5s	104
Salt Lake City, Utah, Water 5s	101¼
City of Chicago, 20 year 4s	105½
City of Marion, Ind., 5s	110½
City of Omaha, Neb., School 5s	109¼
County of Otter Tail, Minn., 5s	105½
City of Galveston, Tex., 5s	104¼

RAILWAY STOCK MARKET.

New York, Nov. 26, 1894.

What with the reduction of the quarterly dividend on Chicago, Burlington & Quincy stock, and the continued reports that the Chicago & Northwestern Railroad Co. is to follow the example of the Rock Island and Burlington railway companies by also reducing its dividend on the common stock, the railway stock market has had sufficient excuse for developing a decided bearish tendency. Yet the reactionary trend of the railway stock market was hardly commensurate with the decided unfavorable symptoms developing last week. The unwarranted but slight premium on gold, and the continued prostration of trade were some of the influences directing the course of prices, but fortunately the narrowness of the stock market prevented such declines as would tend to create apprehension.

Everybody now feels assured that the Northwestern's dividend on the common stock to be declared this week will be reduced from 3 to 2 per cent., but "everybody" was just as sure a week ago that the Burlington dividend would be at the old 5 per cent. rate, and it is just as likely that Wall Street omniscience will again prove a fairy tale. Good reasons for believing that the Northwestern's directors will stick to the old rate are found in the fact that the same interests control Northwestern as outline the policy of the New York Central, and the latter road, while relatively in a much worse condition than Northwestern, has not reduced its dividend, although it was not earned by a good round sum, whereas the Northwestern dividend is about earned. But the day of declaring regular dividends with borrowed money from a false motive of pride is happily passed, and conditions are more and more taken into account. The late Mr. Gould pocketed his pride in Missouri Pacific's long and proud record of uninterrupted dividends when he ordered it passed when not earned, and his heroic example should be better followed. It is undeniable that the Granger roads are in a most unhappy condition. St. Paul in four months of 1894 hardly earned ¾ of 1 per cent. on its common stock, where in 1893 it earned 1¼ per cent. for distribution among common stockholders. The outlook holds out very little promise of great improvement and conservatism is the watchword of the day. Northwest may or may not reduce its dividend. The latter action is more probable, but neither action will cause much surprise, although an official revelation of the fact that the dividend has been earned will prove a tremendous bull factor.

The advance in the price of cotton has created quite an investment demand for Southern railway securities. Business matters in this section of the country are again forging ahead, and the outlook for renewed prosperity is very bright. In the stock market, Southern railway securities are among the strongest on the list.

The daily sessions of the railway stock market continue to be characterized by dullness, but stagnation at this period of the year is not unusual, though it is a little more pronounced than ordinarily. The success of the Government loan is, however, having a very stimulating demand at home and abroad, and the good feeling will likely soon find expression in renewed buying and increased quotations.

RAILWAY STOCK MARKET.

Railway stocks.	Closing prices Nov. 26
Alton & Terre Haute	37½
Atchison, Topeka & Santa Fe	5½
Baltimore & Ohio	66½
Canada Southern	51½
Chesapeake & Ohio	17
Chicago, Burlington & Quincy	70½
Chicago & Northwestern	97½
Chicago, Milwaukee & St. Paul	58½
Chicago, Rock Island & Pacific	61½
Cleveland, Cincinnati, Chicago & St. Louis	37½
Delaware, Lackawanna & Western	158½
Delaware & Hudson	127½
Hocking Valley	17
Illinois Central	90
Lake Shore & Michigan Southern	133½
Louisville & Nashville	53½
Missouri Pacific	27½
Missouri, Kansas & Texas	13½
Mobile & Ohio	18
New Jersey Central	93½
New York Central	99
New York & New England	31½
New York, New Haven & Hartford	193
New York, Chicago & St. Louis, 1st pfd	73
New York, Lake Erie & Western	12½
New York, Ontario & Western	15½
New York, Susquehanna & Western	14½
Northern Pacific	4½
Northern Pacific, pfd	18
Philadelphia & Reading	15½
Richmond Terminal	16½
St. Paul & Omaha	34½
Southern Pacific	19
Texas Pacific	9½
Union Pacific	12½
Wabash, pfd	6½
Wheeling & Lake Erie	12

BOSTON RAILWAY STOCKS.

	Nov. 26
Boston & Albany	207
Boston & Maine	156
Fitchburg	83
Old Colony	177

PHILADELPHIA RAILWAY STOCKS.

	Nov. 26
Lehigh Valley	52½
Pennsylvania Railroad	50¼

ADVERTISEMENT.

NOTICE TO CONTRACTORS.

WEST PITTSON, PA., SEWERS.

Sealed proposals, addressed to O. C. Foster, President, will be received by the Borough Council of West Pittston, Pa., until 8 o'clock p. m., December 20, 1894, and publicly opened and read immediately thereafter, for furnishing material and constructing, in accordance with plans and specifications, the sewerage system.

The work consists in furnishing and laying approximately:

12,560 ft. of 8-in. vitrified pipe sewer.
2,180 ft. of 12-in. " " "
3,330 ft. of 15-in. " " "
1,425 ft. of 18-in. " " "
1,320 ft. of 20-in. " " "
2,120 ft. of 22-in. " " "
1,570 ft. of 24-in. " " "
1,680 ft. of 30-in. " " "
Also 150 ft. of 36-in. brick sewer.
300 ft. of 50-in. " "
480 ft. of 2 ft. 4 in. × 3 ft. 6 in. brick sewer.
1,210 ft. of 2 ft. 6 in. × 3 ft. 9 in. brick sewer.
720 ft. of 2 ft. 10 in. × 4 ft. 3 in. brick sewer.
760 ft. of 3 ft. 4 in. × 5 ft. brick sewer.
Also 835 Y-branches.
79 manholes.
44 catch-basins.
6 flush tanks.

The borough council reserves the right to reject any or all bids.

A certified check, 2 per cent. of the amount of the bid, to accompany each proposal.

Plans and profiles can be seen and specifications and forms of proposals procured on or after 7th December at the Borough Council Chamber, or at the offices of the Engineers, 137 Broadway, New York, and 760-761 Lewis Block, Pittsburg, Pa.

By order of the Council,
O. C. FOSTER, President.
H. J. SANDERS, Secretary.
POTTER & FOLWELL, Engineers. 48-3t